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AN EXPERIMENTAL STUDY OF CERTAIN INITIAL PHASES OF THE PROCESS OF ABSTRACTION¹

By HORACE BIDWELL ENGLISH

INTRODUCTION

In all previous investigations of the process of abstraction, the subjects were instructed, generally most explicitly, what to abstract and what to abstract from. Thus Külpe (10) in the earliest study instructed them to attend to one quality only, such as the color, of a complex object; while Fisher (7) in the latest and most complete investigation instructed her subjects to define certain groups—a task which to civilized adults could mean only to abstract the common element. Such procedure obviously leaves uninvestigated the impulse which leads one, without such instructions, to react to a situation by making an abstraction. Is it true, as Max Müller says and as Wundt implies, that abstraction springs from our weakness rather than our strength; that we abstract because we are unable to have regard to the complex fullness of experience? Or must we in some form revive Hume's "distinction of reason?" This is the problem we set ourselves to study.

METHODS

The essence of the experimental method adopted was to put adult subjects in the presence of certain carefully-prepared situations and to require of them a report of their reactions. These were then studied for indications of the first steps toward abstraction. No attempt was made to separate two factors in-

¹A condensation of a dissertation accepted by the Faculty of the Graduate School of Yale University in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

evitably present in any such situations: present experience and funded, past experience. Under the conditions of our experiments, at least, the latter seems always more influential; but the two factors are so closely knit together that separation would be impossible. That particular assimilative union of present with past experience which leads the subject to make an abstraction we shall call the "cue" to abstraction.

In technique, the experiment owes its original inspiration to the experiments of Aveling (3), but important changes, growing more marked as the work advanced, were made. The following acted as subjects: Professors R. P. Angier and E. H. Cameron, Drs. A. E. Avey, R. M. Elliot, J. H. Philp, A. H. Sutherland, and Miss Helen Whitney, Miss Olive M. Jones, Messrs. Mark McChesney, C. A. Murchison, and Gardner Murphy. Messrs. McChesney and Murphy were seniors completing a major in psychology, the others were graduate students and instructors in the department of philosophy and education. Except Miss Jones and Messrs. Murchison and Philp, all had had considerable practice in introspection. To all of these I take this opportunity of expressing, most inadequately, my thanks. To Professor Angier, for advice at all times and help in preparing the results for publication, especial thanks are due.

The experiments divide themselves into four groups: *a*, *b*, *c*, *d*.

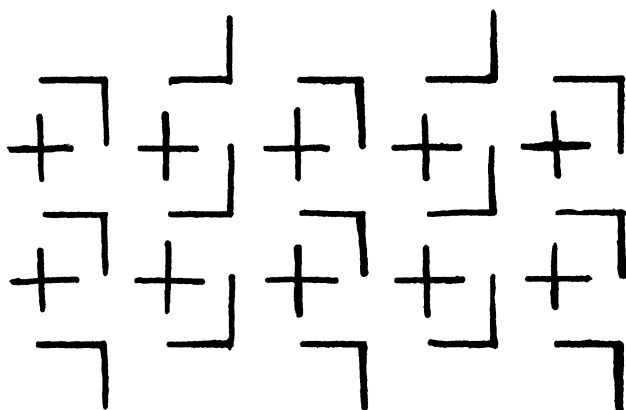
Group *a*

It was in this group that Aveling's technique was most closely followed. "The material employed consisted of ten sets of small pictures and ten nonsense-syllables of two syllables each. There were five pictures in each set. All in each set were sufficiently alike to be designated by some common name; yet each possessed sufficiently notable characteristics as well, by which it could be singled out from the others." Thus Aveling (3, 78 f.).

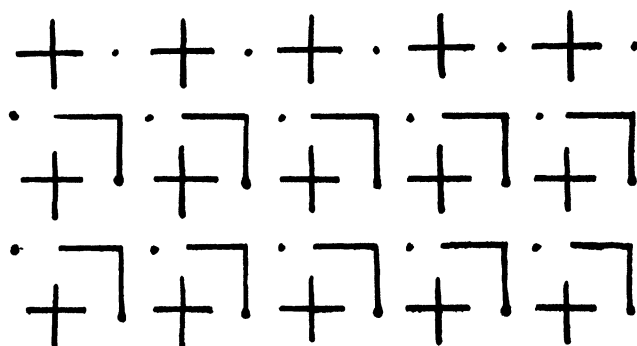
The first seven sets (the only ones used in the first ten sittings) were designed to reproduce Aveling's material as closely as possible. The pictures were of the following classes of objects: Set 1, *Bekis*: curvilinear geometrical figures; Set 2, *Dojaf*: musical instruments; Set 3, *Hexur*: soldiers; Set 4, *Fefiv*: flowers; Set 5, *Wocag*: straight-lined geometrical figures; Set 6, *Tugic*: receptacles for liquids; Set 7, *Vupaw*: fruits.

The common element in each set is thus some familiar class concept. On the basis of our experience with these in the first ten sittings a marked change was made in the three new sets to be introduced for the next ten. The common element was in each set a rather complex, geometrical pattern. This was identical in each member of the set and differed from the other two patterns by certain fairly obvious characteristics (see Fig. 1). These patterns were laid upon various regularly or irregularly shaped colored figures. It is clear that corresponding to each nonsense-word of the first seven sets is an abstract universal, to each nonsense-word of the last three sets, an abstract or abstracted particular.

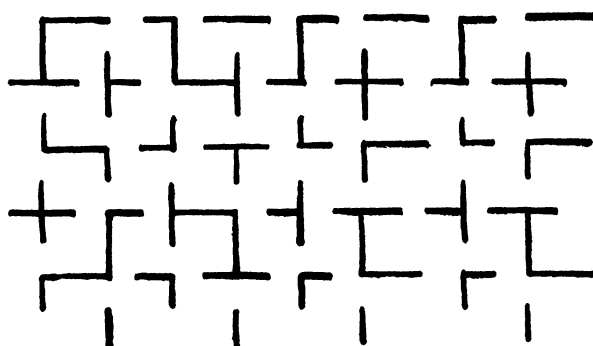
Each picture was shown for ten seconds, then after one minute (during which the subject read or conversed with the experimenter on indifferent subjects) again for five seconds. After two minutes, another picture was shown. A very simple tachistoscope was used. The instructions, which were read verbatim to the subjects each session until perfect familiarity rendered this unnecessary, were as follows:



LIVAB



CIPUJ



JEKOG

FIGURE I

"I shall show you a picture and a nonsense-word for a short time. Repeat the word aloud, once, while you regard attentively both word and picture above it."

Subjects were warned not to think of the experiment during the interval between pictures or between sittings.

For the first ten sittings, one each from the first seven sets of pictures was shown with its associated nonsense-word. In the second ten sittings from seven to nine pictures were shown. This included always one each from the last three sets of pictures and a selection from the seven sets learned in the first ten sittings. Certain pictures were shown more frequently than others. In some cases also, a picture was shown two or three times before a second member of the series was shown. This was done in an effort to bring out the effect of repetition and of dissociation by varying concomitants. Five minutes' rest was allowed after the presentation period. The subject was then placed in front of a simple exposure apparatus and the following instructions were read to him:

"You will now be shown the nonsense-words you saw with the pictures. As soon as the meaning of the word is apparent to you, react by pressing this key. You will be asked to report in what guise or form the meaning comes to you."²

The subjects demanded a definition of "meaning" and were told to give the word its everyday significance.

From time to time nonsense-words not in the series at all were introduced as "Vexierversuche" and in the second ten sittings nonsense-words belonging to pictures previously "learned" but not seen during the presentation period of that sitting were occasionally presented for reaction and report. It should be noted that one subject (An.) was familiar in a general way with the arrangement of the experiments; but full account of this fact will be taken in evaluating and classifying his protocols. Subjects wrote their own protocols and were questioned upon them very sparingly. Sittings were held three times a week and lasted about fifty minutes. The experiments of this group were held in the spring of 1915.

Group b

In place of the pictures shown in Group *a* musical selections were played on a phonograph, the nonsense-word being visually presented simultaneously. Allowing for the change of material, the same instructions were given as in Group *a*. The common element in each of the first four sets was the manner of producing the selection. In the first set, all the five selections were baritone solos; in the second set, duets by male and female voices; in the third, mixed vocal quartets; in the fourth, band selections. The fifth set introduced a cross-classification. All of the foregoing were small ten-cent records requiring less than half the time to play taken by the standard large-sized records.³ The music was not only "raggy" but, except for the band selections, atrociously executed by both "artists" and record manufacturer. Set five consisted of two standard large-sized records, well executed. The music also was superior, even the popular "Tipperary"

²As the buzzing of the Ewald chronoscope used in timing these reactions disturbed and hurried some of the subjects, the stop-watch was later substituted. Even this might have been eliminated, since no use was made of the reaction-times. It is advisable, however, to have the subject react in some decided way in order to put a period to his train of thought; and when this is the case, the stop-watch may be harmlessly employed.

³Our subjects found great difficulty in remembering the selections well enough to form any constant associations at all; and, as the subjects were not allowed to see the records, the visual size of these records could not help them.

being better than the selections on the ten-cent records. Set five, therefore, was differentiated from the other sets by superior aesthetic qualities and by much greater length.

One subject could give but ten, the other but eighteen sittings to this part of the experiment, in which time no real abstractions were made. Certain preliminary stages of abstraction were, however, brought out. One subject (Av.) had read Aveling's book and supposed that we, like him, were interested in "imageless thought." His special knowledge of similar experiments probably played some part, but did not keep his protocols from presenting many points of interest.

Group c

Our experience in the experiments of Group *a* indicated two things. One was that the classification scheme should be more complex and more difficult. The second was that "nonsense-pictures" should be used, *i. e.*, pictures to which an English class-name cannot readily be given. It is impossible by this means wholly to avoid the influence of funded associations, as most investigators have found. It does not follow that there are not very great advantages in the use of nonsense-pictures. In nearly every case, it is true that the visual presentation will be apperceived as "like something" else and that the name of this "something else" will be used as a verbal tag to aid memory. But such a verbal tag will not suggest to the subject the basis of the grouping. An example will make the difference clear. Immediately upon seeing the first picture, *Hexur*, the subjects without exception thought "soldiers". Thus the basis of our grouping was given, and the subject's task was one of differentiation. This is an interesting process but not the one in which we are primarily interested. Upon seeing a certain *Jekog*, the subjects thought "dumbbell". This verbal tagging helped them to reinstate the whole picture, but it gave no clue to the one element referred to by *Jekog*, which was a certain pattern.

It proved to be by no means easy to construct a series of presentations that would answer our purpose. In the end it was decided to adopt the following scheme. A one-to-one relation between certain outlines (see Fig. II) and certain syllables, and between certain other syllables and certain patterns (see Fig. III), was determined upon. Each succeeding day a given outline would be shown, cut from a different pattern-paper, and every sixth day it would appear twice, *i. e.*, cut from two patterns. Similarly and as corollary, each pattern appeared with a different outline each day and with two every sixth day.⁴ But whenever any pattern or any outline was shown, its syllable stood beneath it. Thus beneath each of these composite pictures was an outline-syllable and a pattern-syllable. Other features of the pictures such as color and orientation varied irregularly. The subject saw six pictures each day for two five-second intervals. Between exposures the subject read from a volume of letters. After going through the whole list twice in this fashion, the syllables were presented to the subject one by one and he was required to report his reaction to them.

The following instructions were read by the subject at every sitting until their content was perfectly familiar:

"I shall show for a brief exposure a picture with two nonsense-syllables under it. Regard the whole picture attentively and pronounce the nonsense-syllables aloud once."

"You will be shown one of the syllables presented in the exposition period just finished. When you feel that you know to what it refers, press down this key sharply so that I can hear it click. After a moment's pause

⁴The two presentations of the repeated pattern (or outline) were some distance apart in the series.

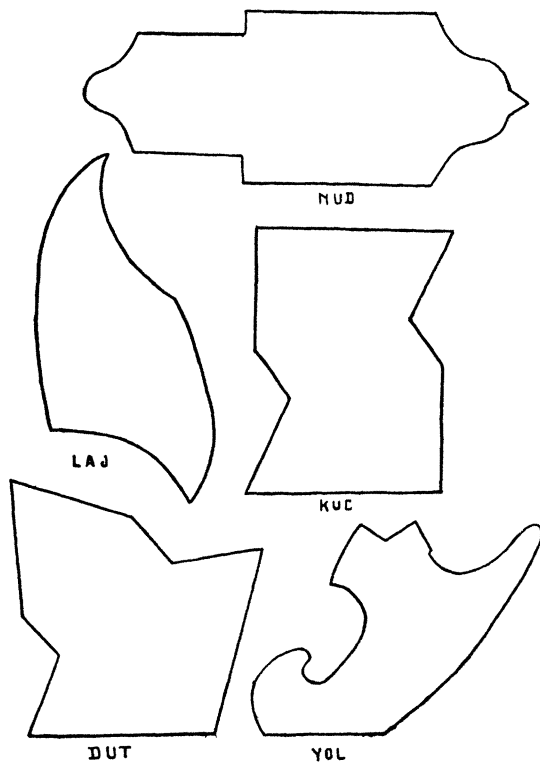


FIGURE II

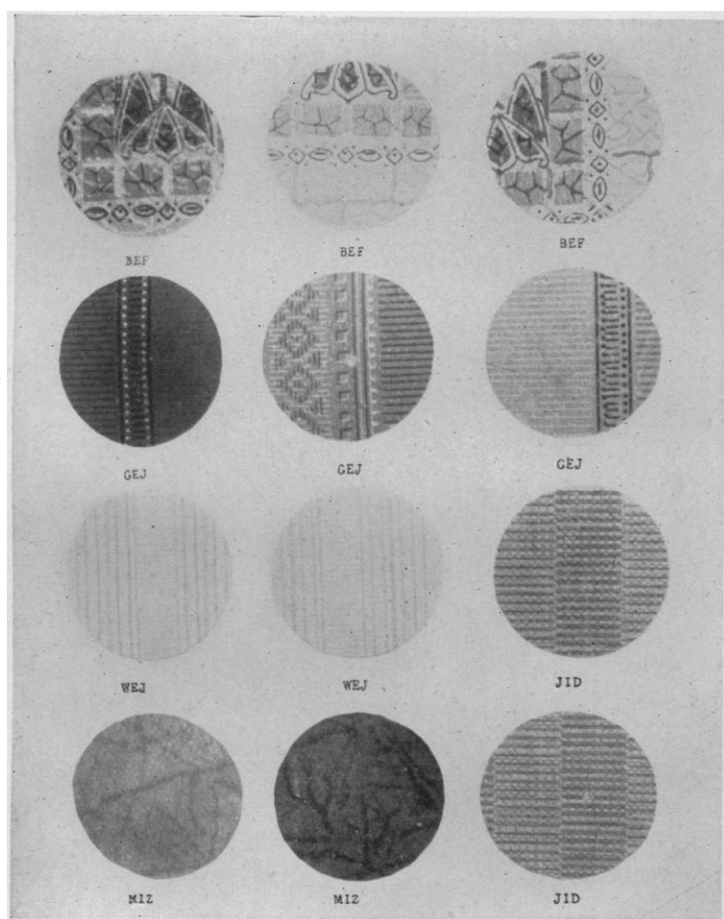


FIGURE III

in order to allow any further mental process to develop which may be relevant to the experience just finished, write an introspection of the experience."

The supplements to these instructions and the influence they had on the subjects will be considered later.

Beginning with the subject's third or fourth sitting, instead of writing his protocol, he was asked to dictate it to the dictaphone.⁵

One subject (S.) was completely inhibited when he tried to dictate an introspection to a machine. He simply could not utter a word and was obliged to write his report. Another subject (J.) was disturbed very considerably; after several day's trial it was decided that she should also be allowed to continue writing. The remaining subjects soon accustomed themselves to the procedure and very much preferred it. Where an experimenter does not know shorthand—as few do—the use of such a machine has very many advantages.

During the first seven sittings the pattern syllable was invariably given first and the orientation of the figures on the card was constant. In the seventh sitting and irregularly thereafter the two classes of syllables were in some cases reversed and the orientation of the two outlines *Yol* and *Dut* was radically altered. The intention was to dissociate these really variable elements from the two essential ones of pattern and outline. The actual effect was at first to draw attention to these variables and to set the subjects speculating on them. Finding no rhyme or reason in the changes, they accepted them as a fact and paid no further special attention to them. Three sittings a week were given during the fall semester of 1915. An. was too familiar with the problem to be wholly naive, while W. was undoubtedly somewhat influenced by her experience as subject in Group *a*.

Group *d*

This was a very short, control series in which the general plan of Group *c* was followed with auditory presentations substituted for visual. One set of syllables referred to the method of producing the sounds, another set referred to the tonal phrases produced. Three instruments were used: a zither (*Vop*), a small tubaphone (*Rev*), and a series of small organ pipes, (*Wug*). The phrases in terms of the key note were: Do-Do-Fa-Sol (*Keu*), Do-La-Mi-Fa (*Faf*), Ti-Sol-La-Sol (*Tuj*). Subjects were not allowed to see the instruments used. The instructions followed the lines of those in *c* slightly amplified, but two subjects (El.) and (Mp.) were told the purpose of the experiment. Another (Mn.) had been subject in *c*, but had not reached an abstraction, and was in the dark as to the purpose of the experiment.

It will be observed that the task set in Groups *c* and *d* is the same as in the latter part of *a*, that, namely, of abstracting from a series of situations a particular (as contrasted with a universal) common to them all.

In quoting from protocols, the initial of the subject is given first. The small letter indicates the experimental group, the Roman numeral indicates the number of the sitting within the group. The nonsense-word presented for reaction is next given, followed, in parentheses in the case of protocols from Groups *c* and *d*, by the syllables presented with it in the "presentation period". Thus P., *c* XII *Yol* (*Bef*) would mean that the quotation was taken from the protocol of Dr. Philp in sitting XII of Group *c*, dictated after reacting to *Yol*, one picture in that sitting having been combined from *Yol* and *Bef* (see Figs. II and III).

It should be noticed that our subjects were in no way required to give an analytic introspection of the process of ab-

⁵This was very kindly lent us by the Columbia Graphophone Co. We take this opportunity of acknowledging the courtesy.

straction. What they were required to do was to report the train of associations aroused by certain words. The nature of these associations, however, throws considerable light upon the progress and nature of the abstractive process. The task imposed did not prove a difficult one, even for inexperienced introspectors, requiring chiefly a fair psychological vocabulary. Nevertheless, we have nowhere based a conclusion upon the evidence of those subjects not accustomed to introspection, unless it is confirmed by one at least of the others. On the other hand, though we did not require it, a certain amount of analytic introspection was offered and is used as evidence.

Since our purpose is rather to discover and illustrate processes which are to be found in abstraction, than to determine those which are not, it is necessary to quote only so much from a given protocol as will clearly exemplify the point under discussion. Nevertheless, a great many protocols are quoted in full, especially where an effort is being made to characterize a certain phase or process as a whole. These reports are marked with an asterisk.

THE PRELIMINARY PHASES AS ANALYSIS AND CONCEPTION

We find that the process of abstraction begins in one of two ways: either the situation-complex is *assimilated as a whole* to some familiar conceptual category; or, where this is impossible, its unity is broken up and the situation is *analyzed* into such of its simpler components as will permit of such assimilation. Since a "real" analysis in things psychical has been denied (*e. g.* by Ameseder 2, 494 f.), it may be well to point out that by analysis we mean more than a distinction of the constituents of an experience. The constituent parts of an experience and the experience itself must be different after analysis. Now, as James says (9, 245), "the law is that all things fuse that can fuse." When, therefore, an originally unitary presentation not only is broken up into simpler components, but *remains* broken up, something must intervene to prevent an immediate recombination. For there would obviously be no inherent obstacle in the way of a fusion of elements which had once been fused.

And it is perfectly clear what this divisive influence is; it is the assimilation of the components to distinct mental categories. In analysis, at any rate as we shall use the term, the various features of the complex situation are thought of as relatively independent elements having validity outside the presented complex, as numerically distinct objects of thought. In James' terminology, they are conceived. If one cares to state it so, therefore, one may say that the first phase of the process of abstraction is the assimilation of the presentation either as a whole or in parts to preformed conceptual categories. Such a

statement emphasizes the essential likeness of the two types we have distinguished; it is more to our present purpose to bring out the differences between the first phase as analysis and as assimilation.

As was implied above, the chief determinant as to whether analysis or assimilation shall take place lies in the nature of the presented situation-complex. If this is some familiar object, assimilation promptly takes place. If, on the other hand, the situation as a whole is unfamiliar or novel, it is broken up, in a manner to be described, into such fragments as *are* familiar. Hence the presentations of the first ten sittings in Group *a* were nearly always assimilated, the new ones introduced in the second ten were more often analyzed. So, too, in Group *c*, most of the presentations were, from the first, subjected to analysis, but a few that looked most like familiar objects were assimilated.

For example, compare the protocols of subject W., taken after the first presentations of *Hexur* and *Jekog*.

"This gave me a visual verbal image of hussar. Then I saw immediately the three soldiers in the blue and buff uniforms. The image 'hussar' and the visual image of the picture seemed to be almost simultaneous."

"First I knew I had seen that. And I also knew I had only seen it once, and then I started to think about figures filled in with geometrical signs (visual imagery). I then got a visual image of the white hexagon filled in with 'pluses' and 'angles' done in red ink."

It should be understood that many of the protocols present odd intermediate forms or a mixture of both types. Analysis and assimilation are by no means exclusive. The essential difference between them is, of course, that, in the one case, the situation is treated piecemeal; in the other, as a whole. But it not infrequently happens that, an analysis having been performed, the subject discovers among the components one which somehow serves as a representative of the whole, and thus is led to the conceptual attitude.⁶

THE CUES TO ANALYSIS

Taking up analysis first, our problem may be defined as the finding of the cues of analysis. Since our experiments were carried on with adult subjects, it may seem that we have in the analogy to past experience an easy solution. It is, indeed, too easy. Two forms of analogy may be meant. In one, the subject decides to analyze because he has previously found it profitable to analyze unfamiliar situations. Yet how he is to divide the

⁶"Attitude" is used throughout this paper somewhat loosely in accord with its untechnical but well-established significance, without regard to the question whether the "attitudes" correspond to the "Bewusstseinslagen" of Marbe (11) and Orth (13), or of the "fundamental personal attitudes of the self" of Calkins (6).

complex, to what previous situation the presentation is analogous, is still undetermined. We give some attention to these processes below under the heading of "Deliberate Analysis." Another form of analogy consists of a more detailed likening of the present to the past. Such analogy depends upon analysis far more truly than analysis depends upon it. It is only when we become conscious of the presence in the present situation of the same cues or factors which led to the analysis of the past situation, that past and present are thought of as analogous (cf. Bühler, 5, 338, where such a "Regelbewusstsein" is said to be the basis of analogical thought.)

A second important point concerns itself with language. Although logicians and philologists had long ago decided that language is essentially abstract and analytical, no serious effort has been made by previous experimenters to determine the effect of the use of language upon the analyzing and abstracting consciousness. Yet one finds obvious traces of it at every turn. Thought, as Plato (4, 189 E) says, is little more than a conversation with oneself—at least, for most of us. And the necessity in these experiments of making a report, in words, forced even those not so much inclined to verbal thought to express in analytic terms what may have been a unitary experience. In no single instance in all of the protocols studied (some 2,000 in all) was this factor entirely absent. But it works generally in close union with some other factor, so that the analyzing function of speech is dealt with chiefly under other headings.

1. *Attentional Cues to Analysis*.—During even a five-second exposure attention does not remain upon any one feature of a presentation, nor is it of a constant level. A temporal or, what would seem to be equally effective, a clearness distinction of the components of the complex is thus effected. Exactly what it is that leads these temporally distinct objects to be conceived of as numerically distinct is by no means easy to say, though we shall take up below some of the cues to conceptualization. We may usefully insist at this point, however, upon the part played by language. Once separated in any fashion, the various features of the complex are almost invariably *named*. Now it is theoretically possible to use names and not think about the corresponding concept. Yet the connection between a name and the concept it signifies is so intimate, so frequently exercised, that the name very seldom occurs without at least incipient general notions attending it. Examples of this cue to analysis were very frequent and would undoubtedly have been more frequent had we taken introspections on the presentation period.

W., a VIII, *Hexur*. "I noted that their faces were different and I also noticed the direction in which they held guns, namely, from upper right to lower left."

J., c XVI, *Yol* (*Bef, Jid*). "I noticed in presentation period particularly its position with head lowered and with a red spot on its nose, as well as in central part of figure."

S., c XXI, *Nud* (*Wej*). "Visual image of [draws figure] with vertical lines across surface. There was a hesitation about reacting to this for a moment, but almost immediately the vertical lines leaped into greater prominence and the reaction proceeded."

Mn., c XIV, *Gej* (*Laj, Yol*). "I had two visual images upon the appearance of this syllable. The first one was the candle-flame picture, gray color, with the syllables *Gej, Laj* occurring beneath it. Then immediately it disappeared and I had the revolver picture, deep red color, the syllables *Gej, Yol* occurring beneath it. Then I reacted. I did not react after the first visual image because I felt certain that another visual image was coming, so I waited for it. In the case of the visual image of the candle flame it was the form, the outline, that was the most distinct and clear. I did not pay so much attention to any of the contents of the image. The form of the candle-flame picture was very bright, metallic, glittering around the edge, but in the case of the revolver picture I paid as much attention to the contents of the picture as I did to the form, I suppose because of the deep red color."

2. *Memory Cues to Analysis*.—The exposure of the syllable in the reaction period tends by a law of preferential revival to recall all of the situation with which the syllable was that day associated. But it only *tends* to do so. Some features are remembered quite badly, much is altogether forgotten. This is certainly due in very large part to differences in attention to these features during the presentation. Yet not altogether. Rather must we suppose that the same apperceptive interests (including the innate) which condition attention also favor recall.

In general, this distinction of elements becomes a conscious analysis in much the same way that the attentive distinction does. For several reasons, however, the transition is less abrupt. In the first place, the separation is much more complete. As has been above remarked and as will be illustrated below, some of the elements are entirely forgotten; the separation is here very nearly absolute.

A second and most important cause is the greater part played by speech. For example, after he had described rather minutely his visual images, S. wrote: "All of this was unitary; there was no temporal order in the visual process" (c VII). He is required, however, to characterize his visual image. Such characterization involves temporal separation of the various features; and it involves giving to them some sort of name in order that the experimenter may recognize them—by which means, however, the subject has for himself marked off the element from the rest of the world. This process may or may not occur where the selective function is attention; but, under the conditions of our experiment, this naming and describing of the features thus differentially preserved by memory is obligatory. The subject must tell *what* is vague, *what* clear. We might very

well put all such cases under the heading of "Analysis by Characterization." We prefer to keep these cases under the present heading on the grounds that the influence of memory is always clear, while the influence of the language factor is not always unambiguously indicated as important; and to separate cases otherwise so similar would be obviously artificial. This concrete difficulty in classification will serve, however, to illustrate the difficulty of drawing sharp lines of distinction.

The number of examples classed under this heading is very great, of which we can quote only a few.

An., a XIV, *Jekog*. "Then a blotch of yellow visually and then the yellow dumbbell with its inner pattern. Last not distinct; cannot reproduce pattern now."

C., a XII, *Livab*. "Auditory-motor verbal 'yellow' followed by a vague image of an irregular yellow figure with curved outline. Since writing, some vague visual imagery of figures composed of red lines."

W., a XVII, *Cipuĵ*. "I got a visual image of mustard-colored circle, but the figures inside were pretty dim."

Av., b VII, *Hexur*. "Word familiar, slight period of search; violin recalled, and a part of the melody very clearly."

An., c II, *Yol (Gej)*. "A growingly distinct image of the fancy pistol pointed to the right, red, but with pattern indistinct."

Mc., c VII, *Dut (Miz, Wej)*. "Not sure of color, but I have a good outline of the picture."

P., c V, *Yol (Miz)*. "Also associated visually with a bright silvery picture, the general shape of which does not appear."

S., c IV, *Jid (Yol)*. "With them came a visual image of a cream-colored brownish surface of vague outline."

W., c I, *Bef (Yol)*. "It was not very clear; I could not remember the outline, but then red and green figures (square in form) stood out upon the tan background."

A definite sub-class is formed by those cases where the elements are distinguished not so much by inequality of retention and recall as by their time and space relations in memory. Three types occur: the one feature supplants the other; the one feature adds itself to the other and both persist as a composite picture: or the two are simultaneously present as visual images spatially separated. Owing to the independence of features thus appearing, these cases form very useful aids to conscious analysis. Both elements are present to consciousness, separately noted and (at least in the protocol, if not before) named; yet they are present not as perceived or imagined unities, but as distinct facts.

El., c IV, 6 *Gej (Laj, Kuc)*. "Vest shaped figure, brown stripes. Followed by an appearance of the same figure with a green, slightly mottled surface, much more uniform."

W., a I, *Bekis*. "The word seemed familiar, and then immediately I said to myself 'first', meaning it was first in the series. I then got a visual image of the yellow drawing paper, as I had a decided feeling that the yellow drawing paper was used in the picture. Finally I remembered that I had first seen a circle in connection with this drawing paper. This was a visual image. The whole visual image was then very clear."

An., c III, 4 *Miz* (*Dut*). "Then the image of the same leafed pattern, with the tan hue, and immediately on that the form something like a zed."

Mn., X, 9 *Kuc* (*Miz*, *Wej*). "As soon as I had these two images in my mind, I could see them both, because each picture was of the same shape. It was a picture taller than it was wide, with an angle cut out of each side. One of them was brown and the other was gray. Under the brown one occurred the syllables *Miz-Kuc* and under the gray one occurred the syllables *Wej-Kuc*. Both images seemed to be perfectly clear in my mind. They seemed placed side by side with the syllables very distinct under them, both visual images."

How this subject avoided abstraction under these circumstances may well seem mysterious, but will be explained later.

3. *Associative Cues to Analysis*.—If we are reminded of one situation by another, it is in virtue of some feature or features identical in both. Not only in these experiments but also in ordinary life, the association is "immediate" or "unconscious", that is, the subject seldom or never reasons upon the logical implications of comparison just spoken of. Yet the presence in consciousness of a memory-image composed partly of elements found also in the presented object seems to favor the selective apperception of those elements of the presentation. Külpe (10) and Grünbaum (8) found somewhat similar results. Sometimes, of course, the favored features will be taken as representatives of the whole to which they belong, and in this case we have assimilation. More often the partial analysis begun thus by associative emphasis is continued in some other way. The number of examples of this cue is small in these experiments, but there seems reason to suppose it is to play a larger part under other conditions.

S., b III, 6 *Wocag*. "There was at the moment no reference to the music, but immediately after the reaction there came the meaning 'first exposure; music fairly like Old Black Joe'." The subject can only get hold of that part of the music-presentation which is like a familiar song. This phrase, however, the subject recognizes as merely one element in the song. He remains with what is felt to be an incomplete analysis. Subsequent presentations fail to enable him to complete it, and the subject's attitude gradually changes to the conceptualizing. The only meaningful phrase comes to symbolize the whole piece, and the subject refers to it as "that Old Black Joe plagiarism."

P., c XII, 6. "The syllable *Wej* is associated immediately with *Wej*, *Dut*, and almost simultaneously with the two pictures with the same-colored paper, one of them tall and thin and the other more bulky, smaller. In the images there seems quite distinct a tracing of the lines, especially the reddish lines. All lines are horizontal on the pictures, and *Wej* seemed to stand equally beneath either picture. No other verbal association came with *Wej*, *Dut*, which seems to stand underneath the first, the tall narrow picture, but as far as seeing in any sense the syllable *Wej*, it seems to be under both or under them as a single syllable. The pictures seem side by side and some way *Wej* in just one form stands under them."

4. *Analysis by Characterization*.—It is difficult to exaggerate the importance of our speech-habits in the process of analysis and abstraction. We have seen above that it preserves and con-

solidates the distinction effected by the selective agencies of attention and memory. It has, however, an independent analytic function. Our subjects were required to characterize their reactions to certain stimuli, chiefly in words, though often by drawings also. Now, both of these agencies are analytic. A visual image or a feeling or a concept may come to mind as a unitary experience. Anything approaching an adequate characterization requires an extended description by the use of spatially and temporally separated line-drawings or words. These lines, these words, have all been used by the subject in other contexts; and by whatever mechanism (whether sub-conscious "Bewusstheiten," marginal images, or what not) are present in this context as psychic universals, *i. e.*, as elements in other contexts as well. And it is precisely this process of breaking up a complex into elements having validity outside that complex which we call analysis.

We have spoken as if the necessity of characterization inevitably leads to analysis; and this is not, by our own showing, the case. The alternative is characterization which is incomplete, though adequate for particular purposes. Such characterization is dealt with later and need not detain us here. Whether in real life representation or complete analysis is more common, we cannot say. In these experiments, the comparative novelty of the experience led to more cases of analysis.

Examples, however, are hard to give. For while every quotation in this section and most in the next are couched in a form undeniably analytic, it is difficult to get examples to show that the analysis is *due* to the tools of characterization. Perhaps the clearest example is the following from subject S.:

S., c VII, 8 *Bef* (*Kuc*). "Verbal kinaesthetic processes followed promptly by visual image of creamy background with three green-red smaller figures. All of this was unitary; there was no temporal order in the visual process."

C., a XIX, 1 *Jekog*. "Pronounced word to self. Period of search. Auditory-motor-verbal 'right angle' plus 'attitude'. I shall now proceed to analyze what this latter part means. It is 'plus' (auditory-motor verbal terms) and another 'attitude' which means this figure 1. I can't say whether this last comes as a visual image or not, but probably it does."

J., c II, 6 *Nud* (*Miz*). "The picture as seen in the experiment was visualized. The upper and lower parts resembled small cupolas on buildings."

J., c IV, 5 *Laj* (*Wej*). "It called to mind a picture with narrow green and brown stripes." After writing this, the subject complained that the picture was perfectly clear but that she found it difficult either to describe or to draw. In attempting both, she was forced to analyze the complex.

5. *Deliberate Analysis*.—This is not to be thought of as a sort of catch-all for protocols which cannot otherwise be classed. There are many, many such, but they have been quietly put aside; there is no pretence in this study of either finality or completeness, hence no need to force classification beyond the

point necessary to render the data intelligible. The protocols here dealt with form a very definite class; though, as with all the classes, the division lines are sharper than any individual case warrants. The analysis in all these cases is proposed by the subject to himself as a thing to be desired, and is deliberately and reflectively made. The questions arise: what suggests to the subject that he make an analysis, and how does he know where to put the lines of cleavage?

The nature of the perceived situation largely determines the latter, and our experiments do not offer a sufficient variety of situations to enable us to discover any uniformities. In some cases, of course, the lines of cleavage are already partly marked out by the selective processes of sensation, attention, or memory, as above outlined.

To the former question, the protocols return a better, though still incomplete answer. There seems to be an infinite variety of things which suggest an analysis. One is simply habit. Some people, especially those accustomed to scientific or philosophical thought, attempt an analysis of practically every novel situation in which they find themselves. This appears, however, less an independent suggestion than an aid to the others.

Another very important suggestion comes from memory habits. Quite independently of psychological proof of the fact, many persons have discovered that they can remember concepts better than images, the elements of a situation better than the total impression. Take, for example, the following general report by subject S. offered at sitting XIV (Group c):

"There came to me at about the second or third member of the second exposure the query: 'I wonder if there is not an easier method of impression—by grouping, say.' I then ran my attention back over the members of the series which had been exposed and noted color. This was rejected because no two forms seemed to be the same. Then syllables, some of which I remembered were repeated; but there seemed to be no clue by which to associate them, nothing the same except the syllables; so I gave it up for the time being and concluded without a group."

Another subject, Mn., seems to have given a quite individual twist to this. His procedure was to liken each syllable to some well-known word, then to find in the picture some feature corresponding to that word. Thus, syllable would call up word, word feature, feature entire picture. Needless to say, the task required considerable imagination for its fulfilment. For our present purpose, however, the point to notice is that, in the service of memory, the subject analyzes the presentation.

c III, 5 *Yol* (*Wej*). "Then I immediately remembered that when I saw the syllable a few minutes ago I connected it up with the word 'yawn'. Then I tried to associate the word 'yawn' with the picture which was given, and I remember now that it was the picture of a revolver. I tried to make that picture of a revolver look like 'yawn' during the presentation of the series, but I could not succeed; but I remember very distinctly the attempt. I do not recall the syllable which occurred with *Yol*."

c III, 8 *Wej* (*Yol*). "I tried to find something in the picture with which it occurred that resembled a wedge. I tried to find some visual association that would help me to remember the syllable when it should occur again in the part of the experiment that is now going on, but I can't recall the picture; I can only recall that it was very difficult for me to find anything about it that resembled a wedge. It had too many curves. The syllable is getting mixed up in my mind right now with that picture that resembled a revolver."

c IV, 4 *Kuc* (*Gej*). "I immediately remembered this syllable as one that in the former experiment had occurred with the syllable *Bef*, and the picture somewhat resembled a piece of beef under a microscope. When the series was first begun, at the beginning of this hour, this syllable, *Kuc*, was presented to me in combination with another syllable, *Gej*. They both occurred with a picture which somewhat resembled a letter 'z'. The picture was built up in three sections, dark gray in color. I wondered, at the time, when the picture was first presented to me, why the syllable had been changed. That made me take particular notice of what syllable it had occurred with and the kind of picture it occurred with."

The last of these as a mixed case will serve to introduce us to the next form. The subject is conscious of changes: perhaps he notices the lack of a certain feature where his past experience led him to expect it, perhaps he simply realizes that there has been an alteration. The result is the same, an analytic examination to discover what is changing, what is constant.

P, c VI, general: "It has seemed to me that while the shapes of the pictures remain the same, the position of the different shapes changes somewhat and the colors are not always remaining the same for the same shape of pictures, though the same shades of colors seem to be present in the different experiments. The syllables, too, seem to be changing somewhat to make new associations."

A single protocol from subject J. also clearly belongs here.

c X, *Nud* (*Miz*). "The figure within the square made me think of a butterfly, but its red color was inconsistent with that object." Here the subject is struck by a resemblance, but notices also the incongruities. This leads to an analysis to make clear the points of likeness and difference, in this case shape and color respectively. There is small doubt that there are many other suggestions which might lead to deliberate analysis, but these are all that gave evidence of themselves in the protocols.

Analysis would seem, therefore, to be furthered under our experimental conditions by cues depending upon the occurrence of such functions as attention, memory, association, linguistic or allied characterization, and deliberate intention. That the list is complete, even for our experimental conditions, is not contended; but a careful sifting of the protocols fails to bring others to light. Clearly the attention and memory cues belong together as aspects of the selective nature of consciousness. The different features of the presentation have, so to say, different values for consciousness. The position is not clear of the third mentioned, where that element of a presentation which acts as the associative link is subjected to analysis; but on the whole it, too, would seem to be a case of "apperceptive" effectiveness of such a presented feature. Language and allied symbols

are so essentially social that the cues to analysis through "characterization" might even be termed the social cues, even in those cases where verbally-minded subjects characterized—and thus analyzed—without reference to the necessity of making a report. The apparent self-determination of consciousness (which must be accepted as a phenomenological datum) sharply distinguishes the last cues from all the others.

It may not be from the point again to call attention to the somewhat artificial nature of this classification. The necessity to characterize and the determination to analyze can never of themselves lead to analysis since they do not indicate lines of cleavage. On the other hand, the cues of the "selective" group do indeed mark out division lines, but do not suggest that these be followed. In short, analysis is essentially a single, unified process. Yet one must not neglect the fact that in the one case the emphasis in the subjects' protocols was upon the lines of cleavage; in the other, upon the need to follow them. Nothing that has been said above is intended to convey the idea that any of the cues is exclusive of the others. So little is this the case that the chief difficulty has been to disentangle them sufficiently to render classification, and hence intelligibility, possible.

THE CUES TO CONCEPTION

The inveterate tendency to apprehend facts in various relations (which seems to be the fundamental impulse towards analysis) may be satisfied not only by analysis, but also by conception. It will come as a shock to some to find conception put at the beginning instead of the end of a process of abstraction, and the question will at once be raised as to what we mean by the term. We mean that the presented object is perceived *as something*, is thought of *as a case or an example* of something, is assimilated to certain mental categories. By whatever name it be called, this is often a first step to abstraction.

If we bear in mind, as we must always do, that the subjects of this experiment were adults, the statement loses its mystery, even for those who are committed to the view that our concepts are reached by a process of abstraction. Our subjects were able to (and did) use constantly the concepts attained, if you will, by previous abstractions. The object is conceived as a member of a certain class. Now in strict logic, it belongs to a class only by virtue of its possession of certain abstract qualities, and it is very easy for an arm-chair psychologist to imagine that some sort of analysis is presupposed whereby these qualities are separated from the others. Such analysis, however, gives no evidence of its presence in the subject's consciousness. If anyone thinks that he makes the facts clearer by saying that the analysis takes place subconsciously, we shall not object. We merely

insist that this analysis is not, in these cases, part of the abstraction process as conscious fact. Our problem at this point, then, is to discover the cues or motives which lead the subject to assimilate the object perceived to some concept.

This assimilation is rather "rough and ready", apparently "intuitive." (We shall see that the intuition is prepared for.) In defining more carefully the exact conceptual meaning of the object, an explicit analysis often becomes necessary. But the analysis in this case follows the conception, whereas, in the cases just considered above, it precedes. In what follows, it has been assumed that essentially the same sort of process is involved when a certain feature is treated as a representative of the whole situation, and when the whole situation is taken as a particular instance of a more general category. This has been the traditional view and Avey (4) has recently found justification for it.

1. *Assimilation by Translation into other Sensory Modalities.*

—It is, perhaps, only in those cases where the two senses must present the situation in quite widely different terms that translation from one to the other leads to assimilation. The whole process can be made clear by a concrete example. The common element which stood in one-to-one relation with the term *Bekis* in Group *a* was "circularity" or, more accurately, "curved geometrical figure-ness." Upon being shown *Bekis* for reaction in the second reaction period, subject W. wrote: "I had a motor image, which was that of moving my hand in a circular direction." She had seen with *Bekis* a circle and an ellipse. Her motor imagery was not fine enough to represent the differences between these two figures. Instead it could only represent the grosser aspect common to both presentations. Through the translation to motor imagery there has occurred precisely that emphasis upon the common element of two objects which leads to their assimilation to a common class.

The same subject began a very interesting development when she first saw one of the flower pictures called *Fefiv*. The particular flowers were hyacinths. She writes:

*W., *a* I, 2. "I first had an auditory image of the word fragrant, as I had said this to myself in connection with the learning series. I think I had a slight olfactory image."

A little later this passes over into a distinct olfactory image.

W., *a* III, 3. "This first gave me an olfactory image of the smell of flowers (I can't tell what kind)."

*W., *a* VIII, 7. "I had an olfactory image of smell of some kind of flower. Then I had an idea of flowers in general which seemed to get me all confused until I finally got the visual image of the apple-blossoms."

This general meaning of *Fefiv* as fragrant develops to the point where a presentation is rejected as a proper associate because not fragrant.

*W., *a* VII, 2. "I immediately got a visual image of golden rod. I had a feeling of dissatisfaction because I do not think golden rod goes with *Fefiv*; for the flowers that I connect with it are all particularly fragrant ones."

The process may seem to be analytic and to belong to the cues given above. As was pointed out there, however, whether a given case is analysis or assimilation depends upon the subject's attitude. If the subject regards "fragrant" as one of the many qualities of the object and seeks the others, we have analysis. In the cases here cited, however, this is not the case. Fragrant is looked upon as expressing the essential quality of all *Fefw* situations, so that, as in the last protocol quoted, anything not fragrant is rejected.

Nearly all of the examples of this cue appear in the protocols of this same subject (W), who is the only one with a rich outfit of imagery in practically all the sense modalities. One may note also a protocol from An., a XVIII (*Cipuj*), which seems to belong here: "The filling pattern seems 'full', has tactual value." The complexity of this pattern was, as a matter of fact, its chief distinguishing mark.

The following two quotations from J. show incipient assimilation which presumably met with negative instances, since it does not develop.

c VII, *Wej* (*Dut, Yol*). "I remember that during the presentation period, the picture (perhaps its color) gave me the feeling of something cool."

c X, *Bef* (*Laj*). "During the reaction period (not upon first presentation) I followed the outline and thought of a dog at home."

2. *Assimilation by Translation into Feeling Terms*.—The essential principle is almost exactly the same as in the section just preceding. Not only this, but it is doubtful if some of the protocols here quoted do not belong there. The subjects are not unlikely to use the term 'feeling' rather broadly. We have accordingly brought together here not only those cases where the general meaning consists of feeling in its strict sense, but also those cases where the general meaning is so vague as to be described quite untechnically as a "feeling." This feeling stands as the general meaning of the exposed word, just as the olfactory imagery of fragrance or the motor imagery of a circle stood for the general meaning of their words. In short, we are dealing here again with the representative function.

An., a III, *Fefw*. "First came a feeling-tone of lightness and delicacy attached to the term; then the verbal image 'flower'; then the visual-verbal image of the lilies."

It is uncertain whether the next two protocols belong here or not.

*S., b III, *Tugic*. "In kinaesthetic terms, 'that meaningless, unmusical piece', so designated since I was unable to catch a single word, and the roughness of the auditory impressions was decidedly unpleasant."

J., c V, *Yol* (*Miz*). "The sight of *Yol* made me associate it with a large, massive, strong object, which brought to mind the elephant." Here the association is apparently due to an organic kinaesthesia-complex, only with difficulty distinguishable from a feeling. A hint of one way of forming analogies is given us.

3. *Assimilation by Apperception of Use*.—The functional psychologists have done good service in calling attention to this process, though their insistence upon it as the essence of conception and abstraction is certainly one-sided. Use is a more general category than the individual percept. We may use quite

different objects for the same end. Hence if an object is perceived as "something to drink out of," a concept is involved, the object has been assimilated to a certain category.

There are only a few instances in the protocols of this sort of process. Indeed, except for the sets of "musical instruments" and of "utensils to hold liquids" in Group *a*, there were no objects which lent themselves readily to being thought of as useful. Under ordinary conditions, this form of conceptual assimilation must be much more common. The only cases relate to the *Xugic*-set, the liquid containers. In the case of the "musical instruments" set, if their use was part of the concept, as seems altogether likely, this aspect was not at all prominent.

W., *a* IV. "The image of holding a receptacle to drink out of," and the subject adds what would make a good example for section 1—"not visual but rather in tactual terms."

The next is a mixed instance, but the concept of use is, nevertheless, very clearly present. It shows how the particular becomes general by apperception of the use to which it is put, and the case is in nowise hurt by the fact that the process is hastened by translation of the visual into motor imagery.

W., *a* V. "The visual image of the glass came immediately (reacted). This was followed by motor images of the movements I should make in taking up something and drinking from it."

*W., *a* VI. "A visual image of the glass in which the curves at the top were most conspicuous. There seemed to be at the margin of consciousness the idea of something to drink out of; I'm not certain, but I should say it was in motor and visual imagery. (Act of drinking.)"

C., *a* V. "Reacted to 'attitude' followed by auditory-motor image of word 'drinking'."

In all three cases, the concept is too narrow; but when an instance is found which will not fit, the concept is altered as little as possible. Thus, as will be seen in the following protocol, the use-concept is retained, slightly broadened.

*C., *a* IX. "Auditory-motor verbal 'Drinking vessel'. Feeling that the word is not defined by this meaning. More clearly defined it meant something to contain liquid, but this is an after-thought."

4. *Representative Assimilation*.—In order to render it more manageable, a complex situation is often, as we saw above, broken up or analyzed. This is not the only method. In the protocols we have to deal with here, the subject selects some feature (usually the most prominent or the most essential) to stand for the whole, and this is dealt with as if it were the complete presentation. This implies partial disintegration, but not a conscious analysis of the situation. Indeed, the attitude of the subjects is entirely different in the two cases. In true analysis, we get the tendency to handle the situation in small bits and to follow up to the relations of each feature. In the cases we have to consider, the subject's tendency or avowed purpose is to deal with the situation *as a whole*, and the one feature is chosen because, as a representative, it makes this possible.

W., *a* XIV, *Dojaf*. "I had a visual image of a little white circle, and immediately I knew it was a graphophone, for this little white circle was on the horn of the machine."

W., *a* XVI, *Wocag*. "Then I tried to get a visual image and all I could get was something like this: two lines forming a right angle, although it meant rectangle to me."

Av., *b* VI, *Livab*. "Piece which starts with a whistle; I don't know any name. I find myself looking for something to hold to for identification."

S., *b* III, *Xugic*. "A more definite kinaesthesia appeared, to indicate a particular piece whose name I do not know but which was, I think, a quartet."

S., *b* VII, *Livab*. "The reference was to one of the phrases in the song which I could make nothing of except 'Wiggle de cag'."

Subject J. writes, in *c* VI, *Kuc*, of "the rectangular one with cut-out sides;" and later, in *c* XVI, *Kuc*, "the cuts in sides of picture in the image as also in presentation period seemed to me to belong to *Kuc*, and *Kuc* to them."

Mn., *c* X, *Bef* (*Laj*). "I know that it was a picture that was a brownish color and had a little figure of a rose-bud in the center of it. I am quite sure of that, for I have been in the habit of associating the syllable before with that little red figure in the center of the picture. I remember having recognized that this morning."

A definite sub-class is constituted by those cases where the blurring of the image leads to conceptual assimilation. A vague, confused, or incomplete image can be identified only as belonging to a certain class or group. Its individuality is lost. Although "logic-mongering" psychologists have often talked as if this were the only type, comparatively few cases occurred. The subject cannot at first identify the "fragrance" as the odor of any particular flower. The motor image is too crude to represent a circle or an ellipse; it represents curved lines in general. Many of the "feelings" are almost certainly such vague images in complex settings. We have brought together here, however, chiefly those protocols in which the assimilation is not helped, as in these cases, by other cues.

*An., *a* X, *Dojaf*. "Prompt meaning of musical instrument, not in visual-motor verbal terms, but a faint kinaesthetic attitude towards a semi-circle of schematic instruments surrounding me, *very* schematic and faint. The image of the piano came, rather non-significant, just as I reacted."

*An., *a* X, *Xugic*. "Blank with mere recognition of the term as such. Then the visual motor verbal image (fruit). I then reacted; but as I was reacting the real meaning 'budded in' carried by a visual image of some sort of receptacle and thus of the bucket. So far as these new meanings come, they seem to come by means of a fading away of the outline and colors into the fringe, leaving the pattern in bold relief."

C., *a* III, *Dojaf*. "Reacted to verbal imagery 'musical instrument' and vaguest sort of visual image of the instrument (I don't know what)."

W., *a* IV, *Hexur*. "My idea of soldier seemed to consist in a visual image of a soldier's arm supporting a gun; the rest of the figure is gone."

W., *a* VII, *Vupaw*. "It consisted in a decidedly mixed-up mass of visual images of different fruits and some gustatory images of the same."

5. *Assimilation to a more General Class through Failure of the Particular*.—Only three good instances of this class were found, but all are quite unequivocal.

W., a VII, *Wocag*. "I had a visual image of the geometric figure; I could see it ever so plainly, but it was an appreciable time before I could seem to think of trapezoid. (When I did it was in visual verbal terms.)"

It is perfectly clear what happened here. The image was a particular, but the subject found it a little difficult to name, trapezoid not being a name one uses often. Before she could recall the particular name, the general class name and its concept—viz., geometrical figure—occurred spontaneously.

C., a IV, *Bekis*. "Vague visual image of a curved geometrical figure followed by auditory-motor image of word 'curve'."

Much the same process is here going on. The *Bekis*-figure shown in sitting IV was the curved figure without any name. Now subject C. in these experiments remembers chiefly by visual and motor verbal, supplemented by a concrete visual image. In this case his verbal "tag" is lacking. Hence a failure of the particular to appear and the instancing of the general. As regards the image, of course, this protocol resembles the cues of the "blurred" image class.

Very similar to the last is the following:

W., a IV, *Wocag*. "There seemed to be a moment in which I was conscious of nothing save just knowing that word. Then I thought of geometry (which consisted in a visual image of certain pages from a Geometry book). This developed finally into a visual image of the triangle."

There can be little doubt that this sort of cue is more frequent in real life situations than under our experimental conditions.

6. *Assimilation by Immediate Association of the Situation with a Class Name.*—The connection between class names and concepts is so intimate that an association of a situation with the name is tantamount to assimilation, if the concept and the situation are not irreconcilable. For all that, the class is, it must be confessed, somewhat unsatisfactory. The main difficulty arises from this fact, that "immediate" associations are usually either impressionistically reported associations or associations with a history. Yet if the following protocols be examined one by one, a certain degree of uniformity will be found to justify their being grouped together.

*C., a IV, *Bekis*. "Reacted to 'attitude' followed by auditory-motor image of word 'curve', followed by visual image of circle on cream background."

*W., a VIII, *Vupaw*. "I think I had only a visual verbal image of the word 'fruit' in this connection."

*W., a VIII, *Dojaf*. "I knew this had something to do with music as soon as I saw it. I said to myself, 'this means music,' but it was not till some time after that I connected it with the piano."

J., c IV, *Gej (Laj, Kuc)*. "The sound of the word elephant was heard while thinking about syllables and I sought to find reason for it. The picture, in brown and tan, occurred which, on first sight, resembled a picture of an elephant."

An interesting sub-class, if not a special group, is constituted by the following protocols. In all of these, the syllable recalls two images, both of which can be designated only by their class name. No doubt the presented object, the picture, had been assimilated before the reaction, though we cannot be sure. It does not follow that there is no gain. The simultaneous presence of the two images, and their designation by a common name and by a single nonsense-word, prepare the way for the nonsense-word to become the name of an abstract quality.

*W., *a* IV, *Dojaf*. "A visual image of a grand piano, followed by a visual image of a victrola (with a horn). Reaction given with image. The idea of musical instruments seemed to follow the two previous images."

*An., *a* IX, *Vupaw*. "Fruit. Schematic visual image of a pile of mixed fruits apparently brought meaning. Later came particular image of bananas. The term 'fruit' came, I think, in visual and motor verbal imagery terms, but very fleeting and faint."

Still less than in the case of the cues to analysis is it pretended that the above cues to conceptual assimilation are exhaustive or adequate. The greater number of the experiments were designed to bring out not the conceptual but the analytic approach to abstraction. Fortunately, since there are thus fewer examples, the types are more sharply defined, there is less overlapping. Yet that the above classes represent more than divisions of convenience can scarcely be maintained. The fact that these divisions *are* convenient, however, shows that the classification is not entirely arbitrary.

Nor is overlapping entirely absent. The first two sections clearly belong together. The nonsense-word is associated with something other than the primary data, with other kinds of sensory images or "feelings." This leads to conceptualization by emphasizing the only quality which unites the two forms of presentation, which is common to both because they are both instances of it.

The cues of the next section (through apperception of use) have this in common with the first two, that they too deal with transformations of the primary data, and that the transformation again brings out that which makes it possible—a more general category.

Blurring of the image and representation belong, similarly, to another group. In these two some one aspect of the primary data is emphasized. In the one case, it is the only clear or "visible" aspect, in the other it may be one deliberately chosen as the representative. In both cases, the emphasized quality is one which unites the presented object to some relatively stable mental category. The two forms often cooperate. Standing between these two classes and the three previous are the cases where a verbal term acts as representative of the primary data. For the name is distinctly "felt" to be a representative rather

than a transformation of the presentation, so closely is it connected with the objects it symbolizes.

All of these classes are of such a nature that, although they involve a developed consciousness with pre-formed mental categories, yet they can assist in developing new categories or in modifying old ones. In the cases of Assimilation through Failure of the Particular and by Immediate Association to a Class Name, this is not true. The cues lead the particular over into the general, but do not take any part in modifying either. They presuppose very definite classes, and classes which moreover have previously included just such objects as the present ones. These two classes, therefore, are clearly much less fundamental than the other five.

A noteworthy point is the relative lack of importance of language in this conceptualization as compared with analysis. A casual reading of the logical treatment of conception would lead to the belief that concepts and terms are identical. And while this extreme position is probably held by few, language is considered a fundamental part of the process by practically all logicians. It can be seen from the above that such is not the case. In most cases, its functions are the strictly secondary, although still very important ones, of clarification, definition, and fixation of concepts. Only seldom did it play a great part in the modification. The point illustrates not so much the divorce between psychology and logic as the necessity for psychology to make an independent study of processes also dealt with by logic.

THE FURTHER DEVELOPMENT OF THE PROCESS

The development of the process of abstraction is necessarily somewhat different, according to whether the first phase ended in conceptualization or in analysis. Conception is obviously very much nearer to a complete abstraction, so much so that at first thought they seem to be identical. But they are sharply divided in fact by a difference in the subject's attitude.

In the one case, the subject views a presentation more or less in its entirety as a member of a certain class, which class is named by the nonsense-word accompanying it. The concrete details of the situation are far from uninteresting; it is rather the concept which is dull. One subject (W.) complained of the *Hexur* (soldier) group that diversity was almost lacking, while in the *Fefiv* (flowers) group there was an interesting variety. The same subject explains that she is not satisfied with knowing the general meaning of the term, but wants always to know what particular *Bekis*, *Dojaf*, or *Hexur* was shown in the current sitting. It can hardly be said, therefore, that there is an abstraction of all save the common concomitants of the given word, although the word is clearly the name of a class-concept.

(Compare the remark of W. in *a* XVI: "I believe if I were to meet a soldier on the street, I'd call him a *Hexur*; *Hexur* and *Fefw* are now regular words for me.")

Yet we have said that conceptual assimilation may serve as a first step towards abstraction. In this way: the "nonsense-word" becomes firmly associated through such conceptualization with precisely the only relevant quality. The abstraction does not take place, however, until the irrelevant is recognized as such, and this is a step in advance of assimilation to some mental category. How that step is taken, what are its cues, to extend the term used above in a slightly narrower sense, the data of these experiments do not enable us to determine completely. Of one thing we may be sure, that relative familiarity of the concept is unfavorable to this change of attitude. Where the concept is easy, familiar, simple, the attention of the subject is turned towards differentiation; where, on the contrary, the concept is relatively new or recently modified, where its boundaries are as yet but ill-defined, the subject will be impatient to save the essential qualities of the concept, for it is these which will serve to differentiate it from others. Hence we find, with subject W., that the very much more difficult new material of the second half of Group *a* leads to an abstraction from the non-essential details in half the time taken for the easy, familiar objects of the first half.

Another factor which helps to change the attitude is what we shall have occasion later to consider under the name of "associative abstraction." The subject finds himself unable to recall aught save the essential quality. This is not yet a full-fledged abstraction, but if he recognizes this *as the essential quality*, he is led to think: "After all, what does the rest matter?" These are the only hints of the cues which cause the change in attitude from conception to abstraction. It will be remembered that conception as the first phase of abstraction was predominant only in the protocols of Group *a* and was not there exclusive.

We can trace the change from analysis to abstraction better in the protocols of Group *c*. In the case of only two subjects did this change spontaneously occur. We must take up their protocols in some detail; but before we do so, a general statement will help to orient us in that study. The change from analysis to abstraction is sudden, apparently intuitive. Now to call a change 'intuitive' is to challenge the psychologist to trace its genesis. We must seek, then, for changes in the protocols which belong to the level of analysis, but which tend to lead the subject away from that level.

We can trace the process most easily in the protocols of subject W. This subject did not approach the experiments of

Group *c* quite unsophisticatedly. She had been subject in Group *a*. More important than this, she knew that the "pictures" were to be made out of wall paper. The latter fact provided her with a ready-made, though not quite complete analysis. The former fact influenced her reactions in several ways. First it undoubtedly caused her immediately to look upon two syllables as the name of the picture with which they were given. That at first the two syllables were considered to be a unit, one name just like John Brown, is obvious from her remark at the end of the first reaction period: "It is very clever of you to make us introspect twice on each picture." That is, each syllable was felt to be the equivalent of one of the nonsense-words in Group *a*. This substantiates the subject's subsequent report that her *first effort had been to keep the two syllables together*.

Her familiarity with Group *a*, particularly with the last three sets, also undoubtedly helped her in her analysis of the figure; helped her primarily, it seems to us, by providing her with the appropriate categories and thus suggesting the lines of division her analysis should take. True, all of the subjects have such categories as pattern, color, form, but they do not bring them into relation with the experiment so immediately. In almost every one of W.'s protocols, one or the other of these categories is used. In the main, this seems to have been reflectively determined; but it was certainly aided by the memory cues to analysis and to no small degree by the attention cues. Two things were particularly striking: the little figure in the *Bej*-pattern, and the red of the *Gej*-pattern. The *Wej*-pattern was also fairly well noted, but the other pictures were merely "those brown ones."

The process as it took place in the first sitting seems to have been as follows: first, a temporal analysis as attention passes from aspect to aspect according to the regular laws governing it; secondly, the assimilation of the aspects thus separated to various mental categories (largely provided by the experience of Group *a*) and the adoption of the analytic attitude, the "set" to apprehend the presentation in more or less elementary pieces (of course these two processes are not temporally separated); thirdly, the "fixing" of the analysis by differential memory for various elements and by the necessity of making a report.

During this first phase, however, the subject has no idea that the pictures are artificial synthetic products of these elements. They are thought of as unities which decompose into, rather than are composed of, the elements. And it is essential to notice that at this stage the two syllables are regarded as really one, a name applying to the pictures as unities.

The next step is a change in the attitude towards the syllables. The effort to keep them together breaks down. The subject is forced to recognize their mutual independence. This process begins in the second sitting. Certain of the combinations are remembered from the previous sitting, especially those making rhymed or otherwise euphonic combinations, such as *Wej*, *Laj*. This combination is not met in the presentations. Instead another context is found for each syllable. For instance in sitting II, *Wej* appeared in two combinations as *Wej Kuc*, and *Wej Dul*. The subject writes on being shown *Wej*:

"First an auditory verbal image of *Wej Laj*. I then said to myself that those went together in sitting I; but I was very doubtful about their being together this time. I felt that there was another word in place of *Laj*, but when I tried to think of it I did not succeed. *Wej Laj* just rang in my ears, and it didn't seem as if anything else could go with it."

Or again, when shown *Laj* a little later in the same sitting:

"That goes with *Wej*.' An auditory verbal image of the two. Also a visual verbal image. I said to myself, 'they go together anyway, even if I didn't have them today.'"

Simultaneously with this there has started another process relating to the syllables which is of great importance. Merely as an aid to the recall of the other syllable, the subject asks herself what was the position of the given syllable in its pair. Even in the first sitting this device was three times resorted to, and in the second it becomes a part of the regular procedure.

This gradually alters its nature. Instead of merely "first in its pair," the syllable becomes "one of those syllables which come first in the pair." The step, which is a most important one, seems to have been taken towards the end of the second sitting and during the presentation period of the third. With this subject, we have no evidence in the protocol how the transition takes place; the classification appears suddenly as a fairly-well established hypothesis. This hypothesis outruns any substantial inductive basis for it, but was explained by the subject at a later period as due to a desire, which could not be repressed, "to beat the experimenter's game." If the syllables could not be kept together, evidently the experimenter meant to keep them strictly apart. Then on what basis? For the first two sittings certain ones were first, others second. Very well, this would serve provisionally for classification. In line with the general plan of the whole research, to give the subject few instructions and to approach as much as possible the conditions of real life, no negative instructions were directed against this attitude.

Having now two classes of syllables independent of each other, what more natural for one who takes this attitude than to seek the things to which the syllables refer? For we have seen that they were from the start regarded as names. Since they cannot

be jointly one name, they must be severally two names. At this point again we must see the very great influence of the subject's previous knowledge. She knew, as has been said, that the pictures were cut out of wall paper, a fact which suggests that the shape and the appearance of the paper are important items *as elements either to be associated or to be neglected*. For, in Group *a*, certain patterns whose color and outline varied irregularly had been given a nonsense-word name, while other nonsense-words were applied as names to outlines (not generally the same as used with the patterns). The subject thus has the categories to which nonsense-word names have been applied by the same experimenter under similar circumstances, and her analysis of the presentations has provided instances of these categories. Pattern and color are not always sharply distinguished from each other but are collectively called "wall paper." In the first protocol, however, where the hypothesis appears, the contrasted elements are pattern and outline.

III *Wej (Yol)*. "First I remembered that this syllable came first. Then I tried to think of the other one, too. I had a visual image of *Yol*. Then after that I had an auditory image of the two syllables. Then I tried to think of the figure that went with it. I said to myself 'That first word has something to do with the pattern of the paper, not the shape of the figure', so I tried to think which wall paper was used. I got a visual image of wall paper made of fine lines going horizontally in gray and yellow. Then the image seemed to take on an outline rather distinct, which makes me think somewhat of an elephant. Then I said to myself 'No, that isn't right, for if it is one of those papers it was covered with either fine pink or fine blue lines', but when I thought of those it did not seem as if they had gone with the word *Yol*, so I thought again of the first image I had had. This seemed right for *Yol*, but I was not sure of it for the other word. However I reacted."

Questioned as to why she thought that this syllable was connected with the pattern rather than with the figure, "the subject could not give a satisfactory reply but added, 'I was beginning to form some associations now between the last syllable of the two [in each case] and the shape of the figure'."

It is impossible from the protocols to trace the exact genesis of this hypothesis. Kant seems to have meant this sort of thing when he spoke of the representation of a method, Husserl calls it categorical intuition (*kategoriale Anschauung*), while Bühler (5) has subjected it to some degree of experimental analysis under the name of "Regelbewusstsein." Yet no one has, so far as the writer is aware, directly attacked the crucial problem of what it is that leads us to propose certain hypotheses to ourselves for experiential testing. It is precisely because our own experiments enable us to show only *that* and not *how* analysis and conception pass over into abstraction that this study has been limited to the initial phases of the last-named process.

We may be permitted, however, to watch the development a little further. One interesting point is this subject's procedure from class to member of a class.

W., III, *Jid* (*Laj*, *Nud*). "First I said to myself, 'It was probably one of those brown ones?' Then I thought, 'No, today the papers were mostly colored.' Then I had a visual image of the pink paper."

W., *Gej* (*Yol*). "First I said to myself, 'Now that was the last syllable.' Then I decided that it wasn't the last syllable, but was one of the first, and so referred to the paper rather than the figure. Then I had a visual image of the red wall paper. Here I reacted. After reacting I got a visual image of the wall paper in this form [drawn]."

W., VII, *Gej* (*Nud*). "First I said to myself, 'Now that syllable goes with the wall paper'. Then I asked myself what wall paper it was. First I thought of the wall paper that is made of rather broad stripes, some of it is red and some of it is brown. Then I said to myself, 'No, that isn't right.' Then I thought of the wall paper in which the figure is made up of fine gray and pink or gray and blue stripes. But I said again, 'No, *Wej* goes with that wall paper.' Suddenly I had this visual image. It was a blue wall paper made in this form: [drawn]. Then the paper seemed to be in this shape: [drawn]. Here I reacted. Just as I reacted I got a visual verbal and also auditory image of the word *Laj*."

Another point of great interest is the fact that although from the third sitting on the subject is always aware that a certain syllable refers to or names only a certain element, negative abstraction takes place to only a small degree. It will be remembered that Külpe (10), Grünbaum (8) and Moore (12) all found that the greater the positive abstraction, the greater the negative. This was due, however, to the common experimental procedure of all three. The result of their instructions was in each case the more or less conscious "Aufgabe" at work upon material possessing little or no organic unity, and could not fail to result in a positive repression of the "unessentials". Our subjects, being left to themselves, followed their own bent. Subject W., while recognizing perfectly the one-to-one relation of the syllable and the presented element, does not consider the other elements as uninteresting and constantly endeavors to recall them.

The case must not be confused with the same subject's tendency in Group *a* to recall all of the various individual "pictures" with which a syllable had been presented. This we denied to be abstraction on the ground that the attention was on the denotation rather than on the connotation of the syllable, as was there required for abstraction. The subject's attitude was perceptual rather than abstractive (see above, p. 38). In the cases now under consideration from Group *c*, the subject is very much interested in knowing what other syllable and pattern had been present with a given shape, say *Kuc*, but these accompaniments are clearly recognized as having no influence on the nature of the *Kuc*-outline or on the meaning of the syllable.

The other subject whose insight came very quickly was El. He started with no such foreknowledge of the problem as W., but he seems from the first to have been unable to repress a tendency to speculate. In the fifth sitting, it became very obvious that his reactions were no longer unsophisticated. Accordingly, after the ninth protocol, he was questioned as to the reaction for the association he had reported.

Question: "What makes you think that *Kuc* is to be associated with that figure?"

Answer: "Because during the initial exposure today a hypothesis, which I have been suppressing, became very dominant, namely: that the second of the two syllables is the one which means the figure associated with it, while the first of the two syllables means the color of the same. It is evident that in all the introspections given today this 'Aufgabe' is controlling me. The hypothesis appeared today very suddenly, as if the

thing had been forming in my mind unconsciously since the previous experiment day, and not at all as a result of this morning's exposures. These exposures, however, have not served to disprove the hypothesis, even if there is considerable doubt of its proof in my mind. This came so suddenly and with such a feeling of success that I am reminded to add that it was present on the first exposure of the series, *i. e.*, of today, and was not at all the result of a deduction formed during the exposures this morning." Later he spontaneously adds: "As near as I can get the first flash of insight, it consisted in remembering that the *Yol*, particularly on the very first exposure of the first series, had always been associated with the 'polar bear'; secondarily, but far less near, the association between *Miz* and the brown with the faint green stripes running through it seems also to have played a part in forming this definite conviction that this is the 'Aufgabe' controlling the experiment."

This reply serves to orient us as we take up the detailed study of his progress from day to day. Especially it behooves us to take particular notice of the protocols concerned with *Yol* and the *Yol*-'polar bear' figure. Of the presentations in the first sitting, little was correctly recalled in the reaction period except *Yol*. The *Yol* outline had been seen twice with *Bef* and with *Miz* patterns, the former being the first presentation of the whole group. When *Yol* was shown for reaction, a fairly complete report was given; *Bef* is recalled to the left of *Yol*, the figure is likened to a polar bear, the brown color is prominent. *Miz* recalls *Yol* to the right with the brown polar bear in the background. *Bef* recalled *Yol* (no order is mentioned) and a visual image of the brown polar bear of which the "head" is clearest.

In the second sitting, *Yol* was seen in a *Gej* pattern of a striking red color. *Gej*, however, fails to oust *Bef* as the associate of *Yol*, but the color of the "polar bear" fluctuates between brown and red, finally settling on red. This sure association of *Yol* with the "polar bear" figure together with uncertainty as to color is very significant. The dissociation of color as being referred to by *Yol* distinctly begins. To some extent in sitting I, and very noticeably in II, the analysis of the pictures is proceeding by the cues of Differential Memory and of Characterization. *Miz* is incorrectly associated with a *Wej*-pattern.

In the third sitting little that is new develops. Few of the syllables recall correct or at all accurate associates. *Bef* continues to be recalled as the syllable associate of *Yol*. The combination of *Bef Yol* is firmly fixed as the associate of the polar-bear figure which appears with "various colors competing." It is strange that with *Bef Yol* so firmly established, no shock was felt when *Wej Yol* was seen. The analysis by the various cues, chiefly Memory and Characterization, has proceeded so far that "form" is distinguished from "color," but "color" is used for the colored pattern.

Sitting IV shows notable advances. At first *Bef* is recalled by *Yol*, which also recalls the polar-bear figure with alternative

colors. When *Bef* is shown, however, the subject recollects that in spite of his immediate recall of *Yol* and the polar-bear figure, *Bef* has been "in an association with other syllables with other figures, but am unable to say which." This is a point of very great importance. The *Yol*-figure is already clearly separated from its accidental concomitants; but, so long as *Bef* and *Yol* are kept together, the abstraction of all other qualities except a certain outline as associates of *Yol* could not take place. Meanwhile, as with subject W., a division of syllables into left-hand and right-hand syllables has been effected. The subject is getting more familiar with the pictures and recalls them more accurately.

Sitting V was the critical one, as the subject's general report cited above indicated. The *Yol*-outline was again the first one shown. *Yol* had in the four preceding sittings become firmly associated with this figure and in the last had thrown off *Bef* as a constant associate. When the figure reappeared in a "new" color and with a "new" syllable, the supposition that the last syllable corresponded just to this outline became unavoidable. We may discount the subject's insistence that it was present at the beginning of the sitting, though some vague inkling may have indeed been present. From *Yol* as referring to a single outline is but a short step to a complete schematization, since as Bühler (5, 338) has shown, we form "*Regelbewusstsein*" with extraordinary facility. All the necessary facts are in the subject's possession: two classes of object-elements, two classes of syllables, and in one case at least a well-established one-to-one relation between a member of one class and a member of the other. The subject somewhat hesitatingly ascribes to a fairly constant association in his mind between *Miz* and its pattern some part in building up the hypothesis. This is so far from being true that *Miz* had previously never recalled its proper pattern. The hypothesis is thus based largely on a single instance *plus* a vague consciousness of the other instances. The subject at once sets to work to test this assumption by the method of agreement and difference, and finds, on his own showing, at least no disproof. In the fourth and fifth protocols of sitting V he announces his conviction that in each case only a color or only an outline is relevant. At the next sitting, two examples of one pattern in different colors bring home to the subject the difference, of which he was already half conscious, between color and pattern. With the formation of this hypothesis, abstraction has clearly taken place.

As before, however, it is worth while to notice a few further points. With this subject, the procedure from class to member of class seems not to be so common as with W., and one may add as with An. Rather, as he says later:

"I appeared spontaneously to wait for the appearance of visual images. When the reference of the syllable is to the left, the first sort of image to appear is usually that of the pattern. Sometimes it inhibits the appearance of any form image and sometimes it doesn't. Usually the pattern image appears before I get the realization that the syllable refers to it, and not *vice versa*."

To the extent that this is the case, it is probably due to the fact that the syllables were less clearly or rather less emphatically divided into two classes. Before he realized to what they referred, Subject An. greeted each syllable with a kinaesthetic jerk, placing it to the right or left, while W. reacts with the verbal kinaesthesia "first" or "second". Neither of these tendencies is found in so pronounced a form with El.; the position of the syllable until after the hypothesis was formed was rather an indifferent detail. Even so, the procedure from the consciousness of the class to the consciousness of the member of the class is by no means uncommon.

El., V, *Gej* (*Laj*). "Introspection shows this 'Aufgabe' governing my search for a color to be associated with *Gej*. This search was unsuccessful unless it be the case that the finally found color, red, is the one which seems to be most probably the correct one. The process of search consisted of running over in my mind the various colors with rejection. Such colors seen were the blue and silver stripes, the brown with the squares of black lines, the brown with the faint green, irregular markings and, finally, the bright red. In the background of my mind was the phrase, 'episodic connections' (between these various colors and the figures involved). In particular the blue with the silver stripes was associated with the vest-shaped figure as I think they were given in the exposure this morning."

VI, 1 *Nud* (*Miz*). "The first datum was the knowledge that this syllable is the second of a pair. In recollection of the theory formed last time this immediately led me to search for the shape of the figure, which appeared fairly distinctly as the figure pointing toward the upper left-hand corner. The consciousness of a peculiar color in which this figure appeared for the first time this morning. The backward association to various syllables was rather prominent, *Bef* occurring repeatedly."

That the hypothesis or "Aufgabe" controls the subject's reactions in ways of which he is not himself conscious is seen from the following fact. Although the subject often made errors after this, he never assigned a pattern word to an outline or an outline word to a pattern.

Negative abstraction becomes increasingly greater with this subject. Images of form are inhibited when the stimulus word is a pattern syllable. In part, at least, this is intentional, in part it seems to be automatic.

We may introduce here points gleaned from the protocols of subject An., who alone of the other subjects attained a fairly complete abstraction. Indeed, having advised the experimenter upon points of procedure, he knew the problem too well to adopt anything but the abstractive attitude, and all his protocols therefore were taken after the point chosen as the limit of our study proper had been attained. We have, it is

true, cited many instances of the cues to analysis or conception from his protocols, but these cues occur as parts of a finished product and could not be given their proper setting in the process if all the subjects had attacked the problem with the same degree of sophistication as to its nature.

It is interesting to notice, however, certain further developments. This subject practically always first assigned the stimulus syllable to one or the other class before associating it to a particular member of the class. In most cases, unless the class could first be determined, the individual associate was entirely inhibited. Negative abstraction was very marked. The subject seemed almost annoyed if he got a visual image of anything "irrelevant," an attitude in striking contrast to that of subject W. On the other hand, in those instances where a pattern-word recalls an outline-word, the latter controls the immediately subsequent reaction and the subject gets an image of a form, *then* of the pattern on the form. The contrary process is not found at all often. In other words, the subject can more easily abstract from the outline. As between color and pattern, decision is not so easy; but it seems likely that patterns, at least the sort of colored patterns used in this experiment, are more easily abstracted from than color.

The progress of the remaining subjects in Group *c* towards complete abstraction was much slower. This has, for our purpose, certain advantages which serve to offset the disadvantage that none of them finished in the number of sittings which could be given to this experiment.

The first is the bringing into clear relief of a process which would otherwise have remained obscure. It depends for its efficiency upon the law of frequency of association. Certain features have been seen with every exposure of a given syllable while other features varied. Thus is established between that syllable and that feature a stronger association, and though the others are forgotten, this one feature is remembered. We shall return to this process later.

The second advantage of the slower progress is that we may by comparing the two groups of subjects throw additional light on the mechanism by which one advances from analysis to abstraction. Differences in detail will be noticed when we take up the different subjects singly, but one great difference may be considered here. It is difficult to characterize it in a word, but one may say that the subjects who did not attain to abstraction attacked the problem *unspeculatively*. They were not trying to "beat the game," but merely endeavoring to make a report in accordance with instructions.

With subject P., the difficulty of making a report was sufficient to check any speculative tendencies for some time. His

whole effort was directed primarily to "finding" the companion syllable of the reaction word; next and less important, its companion picture. In general, his imagery reproduces the presentations rather poorly, even the verbal associations being more often wrong than right. The analysis by differential memory makes only comparatively slow progress since the subject strives constantly for total recall. By the end of the sixth sitting he has advanced only so far as to realize that the various shapes have different "colors" at different sittings, and that the syllable pairs are not constant. This last fact becomes of engrossing interest to him; his whole effort is devoted to recalling, and if possible dating, all the syllables which had ever been presented with the given reaction syllable. The subject explicitly states this as his "Aufgabe" in this sixth and the seventh sittings. Visual images are present only incidentally. It seemed that such exclusive preoccupation with the merely verbal must be broken up. Accordingly preceding his ninth sitting, the following comment was given him to read: "You are away off. You have been verbally associating one syllable with another, making a pair unit. Just remember that each syllable alone means something specific—which is not another syllable with which it may have appeared." The result was immediate. The subject reports:

"There seemed more of simultaneity in the coming of the syllable and of the visual image than ever before. The syllable and picture seemed to be there at once" (IX, first report). "In this instance there seems a strife between a verbal association with *Jid* as *Jid Dut* and a tendency to form the visual image with the single syllable *Dut*. There seems for the first time a tendency to run from the first syllable to the visual imagery" *Dut* (*Gej*). A marked improvement in accuracy of recall follows, in spite of rather poor physical conditions during this sitting.

Nothing in the way of systematization takes place, however, in the next three sittings; but two facts are laying the foundations for it. The reaction syllables in increasing measure call up the "picture" that day presented with them. This is due to several factors. The newness of the laboratory experience has worn off, all the presentations are familiar and, the excessive preoccupation with the syllables having been done away with, the subject is able to turn his attention to the figures. In some cases, although the picture as a whole is incorrectly recalled, the one particular feature referred to by the reaction syllable forms part of the visual image. Since the subject is as yet clearly unaware of any such relation, we must ascribe this to the associative abstraction of which we spoke above.

A second influence leading toward systematization is the recognition that a syllable has "gone with" two figures of different shapes but the same "color."

X, *Nud* (*Miz*). "There was present with it also the association of *Miz* with another syllable and with the same colored picture but a different

shape. The other syllable did not appear, but *Miz* was recognized as having been present twice with the same color, the differently shaped pictures."

Analysis by means of the various cues above described now proceeds pretty well, but the "Aufgabe" of full and complete recall of just what had been presented remains so dominant that all speculation is repressed. In the fifteenth sitting *Bef* is linked, apparently by associative abstraction, to its pattern but the cue is not followed up and no further gain is made.

P., XV, *Bef* (*Yol, Dut*). "This syllable *Bef* is associated with a certain visual image which appeared immediately. The shape of the visual image is not very distinct, but the pattern of the paper is. It is arranged in squares. This visual association came spontaneously and at once. The mind sought to force a verbal association without definite success. The only syllable that did come was *Bef Laj*, but there is no certainty that that is the one this evening. The association between *Bef* and the color of the paper is definite. There is somewhat of a dispute between two shapes for the visual image. One shape seems to be that of the parallel lines at the top and bottom with indented sides; the other the tall narrow picture. No definite certainty as to the shape, however. The syllable, *Laj*, did not seem to be associated with anything. It was the only syllable that appeared."

So near can one come to abstraction without reaching it. Sittings were unfortunately discontinued at this point.

Difficulties with the experimental conditions and consequent over-emphasis upon total recall prevented classification and, above all, speculation about the material, for this subject. This is the outstanding cause for his failure to reach an abstraction. Associative abstraction was in evidence, but its operation can be better studied in the protocols of S. and J., to the former of whom we now turn.

The attitude of this subject was marked throughout by certain uniformities. The first was the effort in the reaction period to reinstate the entire situation experienced with that syllable in the current presentation. Thus he endeavors to recall the associated syllable, the place in the presentation series, and the visual details of the picture. The subject's more immediate memory was thus very good, but he carries very little over from sitting to sitting, apparently because he makes no effort to do so. At any rate, things so remembered are neglected promptly—a very distinct form of abstraction, which, however, could not be studied.

A second feature of this subject's attitude towards the experiment was his effort in introspection to describe his experiences so far as possible in elementary terms, especially in terms of the kinaesthetic and organic sensations in which he does a great deal of thinking. Two examples from sitting V will make this clear:

"Promptly came creamy brown figure [drawn] with two smaller detailed figures on its face. It was accompanied by a general kinaesthesia, particularly of the upper part of the body, and a repetition of syllable

together with *Nud*, as *Bef Nud*. The kinaesthetic sensation from arm and visual image of hand followed. Reaction."

"There appeared a visual image of the green brown figure vaguely outlined, followed after a period by a creamy yellow figure [drawn]. Meanwhile a kinaesthetic complex was somewhat in opposition to it. It did not 'fit'. This was an unpleasantly toned complex which seemed to be a continuation of an expectation kinaesthesia. Verbal processes were vague glosses. The reaction was voluntary as before to end conflict."

This non-speculative attitude of the subject—for it is obvious that he has no place for speculation with all this detail to be attended to—was confirmed by one of those accidents from which even experimental work cannot be free. In the fifth sitting the *Yol*-outline was yellow. The subject noticed the combination Y—(ol)—Yellow, and though rejecting it as irrelevant used it as an associative link between the syllable and the color. Now although in this case wrong, this was a beginning toward an association between one of the syllables and one of the elements of the situation, which had by now undergone analysis in the manner above described. Had this tendency been further followed out, the subject would have undoubtedly arrived at an abstraction much sooner. But at the beginning of the next sitting, subjects were warned "not to use irrelevant associations" (see Appendix, p. 71, for details). Subject S. interpreted this to mean that he was to repress just such associations between syllable and features in the picture as that between *Yol* and the color, which he had at the previous sitting reported. The result is that the syllables are taken to refer to the picture as a whole. For instance in VIII, he saw the *Jid*-pattern in light brown ("white") with the *Yol*-outline and in blue with the *Nud*-outline. *Nud* had been shown moreover with the *Wej*-pattern. On being given *Jid* in the reaction period he wrote:

"Visual image came promptly but as it came there was a feeling as if something organic and kinaesthetic had preceded it, as if there were a preparation for it. The figure first appearing was the white [draws *Yol*] then the blue [draws *Nud*]. At presentation the two had become associated with a single syllable *Jid* and likewise distinguished from a white figure resembling the blue [draws *Nud*]. There was no hesitation in accepting the appearance of one or both as the appropriate meaning of the syllable. *Jid stands for either or both*" (author's italics).

The subject does not seem to have noticed the identity of pattern, but had he been searching for some element in the pictures to correspond to *Jid*, he could hardly have failed to notice it.

Analysis of the situation-complexes by way of the various cues is, of course, complete. In the fourth sitting, the subject tries to systematize the thing a little in the interests of memory, but his first hypotheses are not validated and he gives it up. Later, without any explicit reference to it, he returns to the task and does succeed in the presentation period; the pattern being

identical in the first and third, the outline in the third and fifth. This position-framework is recognized to be the same no matter what figures are given, and hence is again very clearly an abstraction. Unfortunately we cannot trace its development, since in relation to the experiment it was largely accidental. We can only say that it was set up in the service of the memory attitude, which continued to rule, and that the mechanism was a deliberate trial-and-error method.

Before the nineteenth sitting, the subject was asked to "give the specific reference of each syllable". The subject retorted that he had been giving it to the best of his ability. In the first protocol he wrote as addition to the usual report: "The figure was one of the things 'meant' by the syllable—other things were position, exposure period, repetition, setting down introspections, accuracy of description, etc.—the whole group of acts surrounding the perception of the syllable."

It is small wonder that with all of this the subject had not reflected upon the experiment. It must be insisted, moreover, that he had deliberately tried to repress all speculation concerning the problem. When, just before sitting XXI, he was told to find the specific reference of each syllable to some detail or feature of the "picture," he objected that he had been prohibiting just such associations, but that the meanings of at least four syllables had become pretty clear. How he could not say.

From the protocols, however, it is quite obvious how this has come about, namely, by associative abstraction. This has been at work theoretically since the second sitting. Actually its influence has been clearly observable since the ninth. In associative abstraction a firm bond of association is established between the nonsense-word and the element with which it has always appeared, while the varying concomitants are connected less firmly. The difference may extend from a slight emphasis upon the constants together with clear recollection of the variables to a very great emphasis upon the constants together with absolute inability to recall the variables. Where the variables are limited in number and themselves objects of interest, as in these experiments, it more often happens that the constant associate of the nonsense-syllable is correctly recalled while with it appears, not the variable of that sitting's presentation, but that of some other, perhaps quite a long time before.

It is clear that associative abstraction has a great deal to do with the memory cues to analysis. The latter, however, are more comprehensive, including as they do separation of the features of the situation in memory by whatever means, and emphasizing the separation of the different features rather than the connection of one of them with the nonsense-syllable. The outlines were more often thus "abstracted" than the pattern;

and apparently, though not so certainly, color stands between the two. The *casual* operation of associative abstraction is one of its striking features. Nor could anything else be expected. For in addition to frequency, other factors influence association, more especially recency and intensity of impression. Thus it happens that, at the end of twenty sittings, the "specific meanings" of four only out of ten syllables were clear to this subject, while the meanings of all the syllables were clear to one subject who used what we may call the intuitive method at the end of three, to another at the end of seven sittings.

Very much the same remarks hold for subject J. as for subject S. True, she did not attempt, as the latter did, a fine introspective analysis of her reactions. But to write a protocol at all was an entirely new task for this subject (who had had no experience in experimental psychology) and absorbed her best efforts in much the same way as the analysis into elements had absorbed those of S. Like him, she adopted a memory "Aufgabe." Like him, she had begun an analysis of the situation into its elements and was tentatively associating, in a more or less accidental and external fashion, one nonsense-word with a certain element or group of elements when the warning was given in the sixth sitting against external and irrelevant associations (see Appendix). And like S. she interpreted this as meaning that any association of a syllable with some one feature of the presentation was illicit. Her sole duty was hereafter felt to be to observe accurately, report fully, and not to speculate. This last task, she explained later, was by no means easy for her. Continually there came the desire to seek the underlying principle, but she always inhibited it. This is borne out by the protocols. A very striking characteristic of her procedure was her use of the two syllables as one name. It will be remembered that subject W. exhibited the same tendency, but abandoned it when she found that the syllables were used in varying combinations. J. does not thus give up the "name" idea. Each combination of syllables remains a particular name for a particular picture.

J., c XII, *Dut* (*Bef*). "*Bef Dut* visually appeared, then *Wej Dut*. No picture during reaction period. Afterward I saw pictures of both; of *Wej Dut* which is [drawn] with fine green stripes across it; then of *Bef Dut*, [also drawn] in the one square of which was the red butterfly. I realized my mistake made twice in reports of calling the last picture *Wej Dut* instead of *Bef Dut*, its true name."

This type of recall might in time have suggested, in a way that the subject could not inhibit, that *Dut* went with just the outline. Unfortunately, the operation of memory is not uniformly correct, and instances occur where *Dut* is said to go with some other shape. Yet by the end of the fourteenth sitting

some kind of system is really developing. Take, for example, the last protocol, where the reaction word was *Nud*:

"This brought up a visual image and almost immediately the syllables *Wej*, *Nud*, and *Jid*. I thought of the figure in brown [draws *Nud*] and then in blue, and wondered if I should ever be shown it in blue again."

Question: "When did the three syllables occur?"

Answer: "All came with the brown image."

Question: "Which seemed most intimately to mean your visual image?"

Answer: "Oh, *Nud*, then *Wej*."⁶

From the fifteenth sitting on, associative abstraction becomes more and more effective. The shapes begin to be pretty correctly associated with their syllables, but the patterns are not yet names. Take, for instance, the subject's reaction to *Bef*:

XVI. "The picture named *Dut* appeared followed by the picture named *Yol*. [She draws both correctly with indications of a *Bef*-pattern]. In reaction period, I realized that both had in them this peculiar red figure and the same color of background."

Bef soon becomes associated with this pattern; but it should be noted that *Bef* is not thought of as a pattern but as a figure.

An excellent example of how far associative abstraction can carry one is seen in XVIII, where the reaction word was *Bef*.

"This syllable occurred to me as belonging to some picture having butterfly designs in it. It seemed to belong to *Nud* and *Yol* both."

At the end of the nineteenth sitting, the subject spontaneously offered the following remark:

"There is a tendency to associate pictures of one color or pattern, *e. g.*, all the pictures with lines every way in brown go together. Also the different pictures in blue with lines of two shades forming stripes. Both *Yol* and *Kuc* have had this brown pattern."

The experimenter determined to ascertain just how much the subject had learned. Accordingly the following questionnaire took place:

E. "What are *Yol* and *Kuc*?"

O. "*Yol* is the elephant and *Kuc* the picture with the cuts in the side." (Both right.)

E. "Can you name any others?"

O. "*Nud* is the tall picture with the rounded top." (Right.)

Questioned about the other figures, she replied that they seemed to change all the time. As remarked before, both *Kuc* and *Yol* had had this brown figure with lines.

E. "Do I understand you to mean that these are merely rather attributive of *Kuc* and *Yol*?"

The subject was puzzled and denied it. "I used to think that *Bef* was the name of the little red figure, but I don't think I can carry this idea through."

E. "What was the brown lines picture?"

O. "As to name?"

⁶This answer must not be taken as proof of abstraction, as it is in accord with a characteristic set which somewhat hindered the subject's advancement, *viz.*, her tendency to regard the shape as the really important thing, the color-pattern rather subsidiary. *Nud*, moreover, meant the whole picture, brown coloring and all.

E. "If you care to put it that way."

O. "Well, once it was *Jid Kuc* and today *Gej Laj*."

The subject similarly showed no ability to name the blue picture. In the course of the conversation she mentioned *Laj* and the vest-shaped figure.

E. "What about this figure?"

O. "Well, it used to be *Laj*, I thought, but lately there has been a change. *Laj* has been used elsewhere and the vest figure has another name." (This was not actually the case.)

E. "Can you name any other picture?"

O. "*Dut*." (Describes *Dut* correctly.) "We have had *Jid Dut*, *Wej Dut*, and *Bef Dut*; that's all I can think of. (Pause.) That is all of the pictures: elephant, cut, vest, this one and the *Nud* long one." (This last was a sort of thinking out loud.)

E. "Well, now you have five pictures and names of at least four, perhaps for five. What are the other syllables doing?"

O. "Just floating in air, I guess. You see the four syllables keep the name with their pictures (as I said, *Laj* seems lately to have been changed); but the other syllables change. Can it be that the other syllables change when the colors do? [This came to the subject obviously as a flash of inspiration.] Anyhow they are modifiers."

E. "Can you test your hypothesis?"

O. "Well, there's *Gej Yol* and *Bef Yol*." [Describes the latter correctly; for the former she describes *Wej Yol*, there having been for some time a consistent substitution of one of these for the other.] Then there's *Miz Yol*. That has the little red figure. No, that's *Bef*. Well, *Miz Yol* is just brown. That's all the *Yol*'s I remember. There are probably more."

E. "Try another."

The subject tries various colors. *Bef* has always gone with the red figure.

E. "Well, try another figure."

O. "*Kuc*; *Miz Kuc* has the brown wavy lines. *Bef Kuc* has the red figure. *Jid Kuc* I have seen but have forgotten. *Miz Kuc* looks like *Miz Yol*. It really looks in about three-fourths of the cases as if the last syllable goes with the shape and the first with the appearance inside. I can't remember enough to be sure."

In the next sitting the presentation period was omitted and the syllables were presented for reaction as usual. In the second protocol, *Gej* being the reaction word, the subject described a certain visual image. The experimenter then inquired: "Well, what is *Gej*?" to which the reply was given: "*Gej* and *Laj* together make that blue picture. *Gej* appears with other syllables and hence can't be the name of the 'vest' pictures. *Laj* does not appear with any other picture save the 'vest'. When other syllables are with *Laj*, the color changes. *Gej* isn't anything by itself, unless the name of a particular color scheme. I don't think it has any particular group."

With regard to all of the other pattern figures, she declared that they were modifiers and just by themselves meant nothing. It was impossible to draw a *Jid* which was not a *Yol*, *Kuc*, *Dut* or *Laj*. *Bef* alone might possibly stand by itself as the figure which was within the figure. With this much of a start she would undoubtedly have reached a complete abstraction in a very short time, but the sittings already prolonged had to be broken off at this point.

Little additional light is thrown on the further development of the analytic process by the protocols of subject Mn. The analysis was fairly quickly and very definitely made. As has been said above, he also endeavored to reinstate the entire situation by the aid of any sort of mnemonic device. Some of these proved real aids to memory and all of them assisted in an analysis of the situation-complex. On the whole his reports are very detailed and his recall quite correct. In spite of a strong emphasis in the protocols on the visual image, it was evident that he remembered chiefly the verbal terms, either motor or auditory verbal or more probably mixed. He realized that the syllables had been changed around a good deal, and from the seventh sitting at least he realized that the pictures were compounds. But as his entire effort was to remember the presentation as seen with the given syllable that day, this fact is merely mentioned by him in passing.

Associative abstraction plays but a small part with this subject due to the episodic memory methods adopted. Hence, though the recall is fairly complete, there is little peculiar emphasis upon the constant concomitant. The subject was forced to break his sittings at the end of the fourteenth without having reached complete abstraction.

In summary, we find the subjects divided into two sharply differentiated groups according to their method of attack upon the experimental material. The first group had constantly in mind the problem of relevance, which was lacking to the consciousness of those in the second group. In the one case there was a definite intention to abstract, the purpose generally realized as such, to consider certain things only as relevant. In the other case, there was scarcely a trace of such intention.

The writer proposes that this intention be made the criterion of abstraction, and that only the former mode of attack be called abstraction. It is true that the term has been used in a more general sense for the process or processes by which one is more highly conscious of (or conscious only of) certain features of a complex situation. As thus used, it includes attention and what we have called (following Ach) associative abstraction. But this broader use of the term is not happy. For abstraction ceases to have, as immediate experience, any distinguishing characteristic. All of the part-processes described either in this study or in its predecessors are found in other contexts than abstraction. Abstraction in this broader sense would be distinguished from other processes only by the onlooker or by the reflective judgment of the observer. To use the psychologists' bug-a-boo, the distinction is "merely logical." If, however, we are allowed to restrict the term abstraction as proposed above,

a psychological criterion of abstraction as a process is given us in *the conscious intention to consider a given presentation in isolation from some or all of its relations*.

This intention may arise in the subject's consciousness in various ways: from instructions, as in the experiments of our predecessors in this field; from a knowledge of conditions and an acquiescence in them amounting to instructions, as with subject An.; from an analogy to previous experience, as with subjects W. and El. External conditions may favor in greater or less degree the arousal of such an intention; negative instructions can inhibit it to a very great degree; but with adults abstraction is such an habitual reaction-form of mind that negative instructions by themselves are not sufficient. The inhibition of abstraction where the material lends itself to abstraction (and most material does) implies not only very implicit acquiescence in instructions, but a consciousness busily engaged with other problems. With our subjects this intention was focal, but it seems likely that in most cases, after a short stay at the focus of consciousness, it recedes into the background.

The process of "true abstraction" as compared with "associative abstraction" is thus characterized by a difference of content, since in the latter the intention to abstract is lacking. The temporal course of the two is also different: true abstraction is rapid and sure; associative abstraction is in comparison slow and vacillating. Even in the end-result, where the two seem most alike, there is a marked difference. For in true abstraction, one may be distinctly conscious of the irrelevant, but conscious of it *as something rejected*; while in associative abstracting one is generally not conscious of the rejected material at all, or in lower degree. And this other content is not accompanied by a rejection-consciousness. Associative abstraction may appear as a cue leading up to true abstraction, while the reverse is never the case. These differences springing directly out of our experimental results leave no question, it seems to us, as to the inadvisability of considering under one heading two processes, psychologically so dissimilar.

This becomes even clearer when one considers the function of the two. Ach (1) has shown that associative abstraction is sufficient to establish general meanings.⁷ A general meaning, however, is not the same thing as an abstract concept. Abstract concepts are called into existence in the service, immediately at least, of reflective thought. We form abstractions

⁷Ach says that associative abstraction arouses a "Bewusstheit" of the general meaning, but the conclusion is the same even if one reject such creatures as "Bewusstheiten."

because we desire to consider a certain presentation or quality either isolated from all its relations, or potentially in all possible relations.

On the other hand, a general meaning, as the functional psychologists have insisted, exists in the service of practical needs. For this, the closer link given in associative abstraction between the class name and the invariable concomitant of the varying situations to which the name is applied may suffice. Associative abstraction may present to us, as meaning, the general characteristics only of a certain term, and hence may serve to call forth a generalized form of action. But for reflective thought this is not enough. Even though perceived in a welter of concrete particulars, the given quality must be recognized as the only one that counts. This recognition it is which associative abstraction cannot yield. Abstraction in the fullest sense is a process limited to those who have reached the level of purposeful thought; it arises chiefly by means of reflection and in the service of reflective thought.

SUMMARY

Abstraction begins either with analysis or with conceptual assimilation of the presentation. These may be described as partial *versus* total assimilation, for analysis is found to involve conceptualization of the resulting analyzed parts. That which chiefly determines whether the assimilation shall be total or partial seems to be the presence or absence in consciousness of appropriate mental categories, which permit the total assimilation of the presentation without too great violence either to the categories or to the presentation. Yet even where the subject has clearly such a category, a mental "set" for analysis (whatever this may really consist of) may cause partial assimilation.

The process of analysis is initiated by certain cues. In the first group of these, there is a preferential selection, through the operation of attention and memory, of certain parts of the presented material. In a second group, analysis is initiated because of the essentially analytic means of communication; hence these may fairly be called social cues to analysis.

The third group is characterized by the deliberate and reflective intention to analyze. Deliberate analysis may be itself initiated or at least suggested by the other cues (hence we have clearly something of a cross-division), but this form of analysis is marked off from the other cases by the apparent activity of the self. Analysis may be initiated by several, not infrequently by all, of these cues acting in unison. Particularly noteworthy, however, is the great influence of language habits, an influence which permeates our commerce with our environment at every turn and which, by its very nature, inclines us to analysis.

Conceptualization, or the assimilation to certain pre-formed mental categories, is likewise initiated by cues which permit of a certain grouping. In the first group of cues, assimilation is furthered by the fact that one's awareness of the presentation is accomplished through a modification or transformation of the primary sense-data. The presentation is apperceived in terms of other sense modalities, in feeling terms, in terms of use. This translation being only possible by virtue of the fact that both the presented sense-data and the "apperceiving mass" are aspects of a more general class, this class is thus brought into clear relief.

In the second group, the assimilation takes place through emphasis of some part of the primary data, either by blurring of part of the image or by selection of one part to represent the whole. In both cases, the representative element is one which unites the presented object to some relatively stable mental category. Representation by a verbal term is intermediate between the two groups. For although it is strictly speaking a transformation of the primary sense-data, the name is so closely connected with the things signified that it is felt to be a representative.

The cues of the third group presuppose not only definite categories, but that precisely this kind of presentation has previously been assimilated to them. In the first case, the name of the presentation as an individual or particular is inhibited; and, before it can be recalled, the general name comes to consciousness. In the other case, the class name, which itself seems to come unmediated, mediates between the presented situation and the mental category.

Analysis and assimilation develop into complete abstraction by slightly different steps, few of which could be studied under our experimental conditions. Where unfamiliarity made discrimination difficult, the subject is forced to seek out, deliberately or otherwise, the essential or differentiating aspect of the presentation. If this is the element to be abstracted, as is usually the case, such relative unfamiliarity is favorable to abstraction. Attentive emphasis to one aspect passes over easily into intentional neglect of everything else. Associative abstraction, the emphasizing in memory of the constant concomitant at the expense of the varying concomitants, helps very materially, but by itself does not lead to the abstraction of the essential element of the assimilated complex.

A consolidation of the analytic process precedes its change over into abstraction. In our experiments this change took place as the result of an analogy to past experience, an analogy which grew out of a fairly thorough knowledge of the grounds upon which it was based.

Associative abstraction may suffice for the development of a general meaning, but something more is required for an abstraction. The essential element in abstraction is *a definite, though perhaps marginal, intention to consider a certain quality in isolation from any of its particular relations*. Only a mind which is capable of reflective thought has need of such an intention. The "mental set" which includes this intention may be called the abstractive attitude. This attitude seems to be variously aroused: by instructions, by more or less unmediated analogy to past experience, by reflective thought about the situation, by certain intellectual needs. It is this which must be added not only to associative abstraction but also to conceptualization and analysis in order to convert them into full-fledged processes of abstraction. As a final conclusion, one ventures to call renewed attention to the importance of the study of certain problems without giving the subjects definite instructions, not only to avoid the subjects' prejudices but also to avoid profoundly altering by those very instructions the nature of the process ostensibly studied.

APPENDIX

Before the sixth sitting (El.'s seventh), Group c, "the subjects were warned," to quote a note made at the time, "not to use irrelevant associations. For example if 'Bac' should be given, they were not to liken it to 'Bacey' and thence to something in the picture like tobacco. They were even to repress any such tendencies." It is regrettable that the exact wording was not preserved; for this instruction was critical for S. and J., perhaps for P. and Mn. They somehow understood the experimenter to mean that they were not to endeavor to connect any syllable with some aspect of the picture (whereas he meant only to prohibit mediate and external or accidental associations), and it was this which led to the peculiar form of their abstraction. In view of the importance of this change, even a contemporary note is unsatisfactory. At the same time, the following additional instructions were given verbatim:

"I want to make clear certain distinctions. When you see the syllable, it acts as a stimulus to certain experiences. These are, at least in large measure, terminated by your reaction. Certainly all *voluntary* search for an association should terminate, although there may arise *spontaneously* certain relevant experiences. It is to see if such be the case that a short pause is enjoined. Next you are to *retrospect* upon this experience just passed. You are not concerned now—at least primarily—with your present experience but with a past experience. You are to describe, as accurately as in you lies, what took place in your consciousness during the reaction time. If you add what came afterwards—as is proper, if the experience is relevant—make clear that it did come later: '*As I write the above*, I am conscious that it is entirely wrong.' Again, I want first of all your actual experience rather than your interpretation of your experience. I do not bar this latter—indeed I am glad to have it, but I want you sharply to distinguish between fact and interpretation. Moreover, there are two kinds of interpretation. There is the interpretation which comes to you during the reaction period and there is that which comes as you write. The former is *very* important, the latter is often quite useful."

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